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PORTLAND

INTERNATIONAL AIRPORT

Data Package Number 3

Airport Capacity Enhancement Plan Phase II

Terminal Location Study

June 2003

Prepared by
Federal Aviation Administration
FAA William J. Hughes Technical Center
Atlantic City International Airport, New Jersey

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Information in this document is subject to change as Design Team analysis progresses.

16. Abstract

This interim report contains technical data pertaining to the Portland International Airport Terminal Location Study.

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Portland International Airport (PDX)

Data Package Number 3

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LIST OF EXHIBITS

1. INTRODUCTION

Accepted Model Inputs

The Design Team accepted the following model inputs, which were presented in Data Package 1 at the January 16th meeting. These inputs will be used in the simulations. Their details will appear in Appendix B.

- Annual & Daily Demands Simulated.
- Fleet Mixes Simulated – Future 1, Future 1.5, and Future 2.
- Operational Procedures and Percentage Occurrence Simulated – only VFR1 is simulated.
- Fleet Mix Cost of $1,660 per hour in year 2000 dollars–values used in the 2001 Design Team Study.

Airline Groups and Alliances

Exhibit 1 defines the airline groups and alliances. It includes revisions made at the March 27th meeting to balance the number of operations between the two terminals. The study will use "airline group names" associated with the alliance and the terminal location. The Star Alliance will remain in the existing terminal because they have international flights and the customs facility is in the Existing Terminal. The other airlines (or Other Alliance) will go to the new terminal, the Decentralized Terminal or the Centralized Terminal.

We will not use the individual airline names as we did in the Design Team Study. We will use group names (Star, Other, Cargo, GA, and Military), so we can focus on the logical entities. For the Star Alliance, we will use the name "A1" to refer to jets and "A2" to refer to props & commuters. For the Other Alliance, we will use "B1" to refer to the jet operations and "B2" to refer to the props & commuters. Cargo flights will use "C1" for jets and "C2" for Box-Haulers (Cargo Feeders).

Model Inputs

Exhibit 2 has the following model inputs:

- **Exit probabilities and occupancy times for the new runway, with revisions made by the PDX Tower.**
- **Exit probabilities and occupancy times for 28L and 10R, with the Centralized Terminal, when Taxiway E and 3/21 (which becomes a taxiway) are realigned.**
- **Runway crossing links and clearance times.**
- **Runway dependencies for the 3-Runway Case, when southbound props depart on the new runway.**
- **Runway assignments for the 2-Runway Case and the 3-Runway Case.**

Status of Inputs and Tasks

Exhibit 3 shows the status of model inputs and tasks.

Model Inputs from the 2001 Study

The following lists the model inputs used during the 2001 study and this study (and defined in Appendix A):

- Aircraft Classifications.
- ATC Separations.
- Lateness Distribution (Arrival Variability Distribution).
- Gate Service Times (Minimum Turn-Around Times).

Appendices

The appendices contain detailed information:

- Appendix A lists the model inputs from the 2001 Design Team Study.
- Appendix B lists the accepted model inputs for this study.
- Appendix C contains the list of abbreviations and their definitions.

EXHIBIT 1 – AIRLINE GROUPS AND ALLIANCES

(Updated 4/8/03)

Future 2 -- 620,000 annual ops (969 daily arrivals)

Updated 4/8/03

New Name	Airline	Alliance	Terminal	Class Type	# ARR	Subtotal
A1	CO -- Continental Airlines	Star *	Existing	757/Large	48	
A1	DL -- Delta Airlines	Star *	Existing	Heavy/757/Large	46	
A1	D1 -- Delta Heavy & Int'l. flights	Star *	Existing	Heavy	17	
A1	HA -- Hawaiian Airlines	Star	Existing	Heavy	3	
A1	HP -- America West	Star	Existing	Large	17	
A1	UA -- United Airlines	Star	Existing	Heavy/757/Large	81	
A1	WN -- Southwest Airlines	Star	Existing	Large	80	
A2	UX -- United Airlines Express	Star	Existing	Small+	80	
A2	ZX -- Air Canada	Star	Existing	LTP	18	
		Star Total				**390**
B1	AA -- American Airlines	Other	New	Large	10	
B1	AS -- Alaska Airlines	Other	New	Large	128	
B1	HZ -- Horizon Airlines (Large jets)	Other	New	Large	78	
B1	NW -- Northwest Airlines	Other	New	Large	8	
B1	QQ -- Reno Airlines (bought by AA)	Other	New	Large	12	
B1	TW--Trans World Airlines(bought by AA)	Other	New	Large	8	
B2	QX -- Horizon Airlines (turbo props)	Other	New	LTP	160	
		Other Total				**404**
C1	Cargo Jets	Cargo	Cargo	Heavy/757/Large	23	
C2	Box-Haulers	Cargo	Cargo	Small+/Small	67	
		Cargo Total				**90**
GA	GA -- General Aviation	GA	GA	Large/Small+/Small	70	
		GA Total				**70**
MI	MI -- Military	MI	Military	Large/LTP/Small	15	
		MI Total				**15**
		GRAND TOTAL			**969**	**969**

Notes: * CO & DL were placed in Existing Terminal with Star Alliance to balance ops between the 2 terminals.

A1 has the International flights including:
-- Lufthansa with 1 arrival per day in 2003.
-- Mexicana with 3 arrivals per week in 2003.

Horizon has 160 LTP (Large Turboprops)
United Express has 80 Small+
Air Canada has 18 LTP (Large Turboprops)

EXHIBIT 2 – OTHER MODEL INPUTS

EXIT DATA FOR NEW RUNWAY – CENTRALIZED TERMINAL

(Updated 4/8/03)

Runway 28X with Centralized Terminal – Estimated by Tech Center

Exit Distance	X2 2400'rhs	X3 4400'rhs	X4/**X5** 6200'hs	X6 7900'hs	TOTAL
Heavy Usage			80%	20%	100%
ROT			48	58	50 sec
757 Usage		10%	85%	5%	100%
ROT		42	48	58	48 sec
Large Jet Usage		10%	90%		100%
ROT		42	48		47 sec
LTP Usage		90%	10%		100%
ROT		44	50		45 sec
Small+ Usage		90%	10%		100%
ROT		44	50		45 sec
Small Usage	10%	90%			100%
ROT	34	45			44 sec

Values are based on similar exits and motivation at PDX & EWR.

Notes: Distance in feet from threshold

Runway 10X with Centralized Terminal – Estimated by Tech Center

Exit Distance	X7 2400'rhs	X6 4400'rhs	X5/**X4** 6200'hs	X3 7900'hs	TOTAL	Values are based on similar exits and motivation for 10X at PDX.
Heavy Usage			60%	40%	100%	Updated by PDX Tower on 4/8/03.
ROT			48	58	52 sec	
757 Usage			80%	20%	100%	Updated by PDX Tower on 4/8/03.
ROT			48	58	50 sec	
Large Jet Usage			90%	10%	100%	
ROT			48	58	49 sec	
LTP Usage			90%	10%	100%	
ROT			50	60	51 sec	
Small+ Usage			99%	1%	100%	ADSIM wants 2 exits.
ROT			50	60	50 sec	
Small Usage			99%	1%	100%	ADSIM wants 2 exits.
ROT			50	60	50 sec	

Notes: Distance in feet from threshold.

Legend: % - Exit Utilization (percent)
s - Runway Occupancy Time (seconds)
h - High Speed Exit (angled exit)
rhs - Reverse High Speed Exit (reverse angled exit)
* - Combination of h, rhs, and 90° exits

EXHIBIT 2 – OTHER MODEL INPUTS (cont)

EXIT DATA FOR NEW RUNWAY – DECENTRALIZED TERMINAL

(Updated 4/8/03)

Runway 28X with Decentralized Terminal – Estimated by Tech Center

Exit Distance	X2 2400'rhs	X3 4400'rhs	X4/**X5** 6200'hs	X6 7900'hs	TOTAL	
Heavy Usage			80%	20%	100%	Values are based on similar exits and motivation for 28X with Centralized Terminal.
ROT			48	58	50 sec	
757 Usage		10%	85%	5%	100%	
ROT		42	48	58	48 sec	
Large Jet Usage		10%	90%		100%	
ROT		42	48		47 sec	
LTP Usage		20%	80%		100%	Updated by PDX Tower on 4/8/03.
ROT		44	50		49 sec	
Small+ Usage		50%	50%		100%	Updated by PDX Tower on 4/8/03.
ROT		44	50		47 sec	S+ arrivals use Existing Terminal.
Small Usage		99%	1%		100%	Only Small Cargo arrivals.
ROT		45	55		45 sec	ADSIM needs 2 exits.

Notes: Distance in feet from threshold

Runway 10X with Decentralized Terminal – Estimated by Tech Center

Exit Distance	X7 2400'rhs	X6 4400'rhs	X5/**X4** 6200'hs	X3 7900'hs	TOTAL	
Heavy Usage			80%	20%	100%	Values are based on similar exits and motivation for 10X with Centralized Terminal.
ROT			48	58	50 sec	
757 Usage			90%	10%	100%	
ROT			48	58	49 sec	
Large Jet Usage			90%	10%	100%	
ROT			48	58	49 sec	
LTP Usage			95%	5%	100%	Updated by PDX Tower on 4/8/03.
ROT			50	60	51 sec	
Small+ Usage		1%	99%		100%	S+ arrivals use Existing Terminal.
ROT		44	50		50 sec	
Small Usage	1%	99%			100%	Small Cargo use this.
ROT	34	45			45 sec	ADSIM needs 2 exits.

Notes: Distance in feet from threshold.

Legend:
% - Exit Utilization (percent)
s - Runway Occupancy Time (seconds)
h - High Speed Exit (angled exit)
rhs - Reverse High Speed Exit (reverse angled exit)
* - Combination of h, rhs, and 90° exits

EXHIBIT 2 – OTHER MODEL INPUTS (cont)

EXIT DATA FOR 10R/28L – CENTRALIZED TERMINAL (with taxiways realigned)

(Updated 5/30/03)

Runway 10R -- 1996 PDX STUDY (With 2000 Classes) – with CE/E realigned & moved 800' to the East

Exit Distance	E 5400'	---	B5/F 6900'*	B6/C6 8500'	TOTAL	
Heavy Usage			70%	30%	100%	
ROT			53	64	56 sec	
757 Usage	17%		81%	2%	100%	
ROT	46		53	64	52 sec	Updated 5/19/03
Large Jet Usage	17%		81%	2%	100%	
ROT	46		53	64	52 sec	Updated 5/19/03
LTP Usage	41%		54%	5%	100%	Updated 5/19/03 -- LTP treated
ROT	46		55	57	51 sec	as Medium in 1996 Study
Small+ Usage	41%		54%	5%	100%	Updated 5/19/03 -- Small+ treated
ROT	46		55	57	51 sec	as Medium in 1996 Study
Small Usage	93%		7%		100%	
ROT	53		60		53 sec	Updated 5/19/03

Note: Because aircraft would travel an additional 800' to Exit E, 6 seconds were added to the occupancy times for each aircraft class using Exit E. On 5/21/03, the Tower said that 6 seconds is reasonable.

Runway 28L -- 1996 PDX STUDY (With 2000 Classes) – with CE/E realigned & moved 800' to the East

Exit Distance	B6/C6 2500'	B5/F 4100'*	CE/E 5600'	B2 8500'	TOTAL	
Heavy Usage			80%	20%	100%	
ROT			51	61	53 sec	Updated 5/19/03
757 Usage		18%	80%	2%	100%	
ROT		39	43	61	43 sec	Updated 5/19/03
Large Jet Usage		18%	80%	2%	100%	
ROT		39	43	61	43 sec	Updated 5/19/03
LTP Usage	18%	78%	4%		100%	Updated 6/3/03 -- LTP treated
ROT	31	40	54		39 sec	as Medium in 1996 Study
Small+ Usage	18%	78%	4%		100%	Updated 6/3/03 -- Small+ treated
ROT	31	40	54		39 sec	as Medium in 1996 Study
Small Usage	12%	80%	8%		100%	
ROT	34	42	42		41 sec	Updated 5/19/03

Note: Because aircraft would travel 800' fewer to Exit E, the occupancy times for each aircraft class using Exit E were receded by 6 seconds. On 5/21/03, the Tower said that 6 seconds is reasonable.

EXHIBIT 2 – OTHER MODEL INPUTS (cont)

RUNWAY CLEARANCE TIMES (in Seconds) -- WEST FLOW

Runway clearance times define the length of time an aircraft on a taxiway must wait before it can taxi across the runway.

Arrival on Runway: Length of time it takes the arrival to travel from threshold and go past the intersection, or the time it takes the arrival to exit the runway.
Departure on Runway: Length of time it takes the departure to travel from threshold and go past the intersection.
Arrival on Final: Length of time it takes aircraft on ground to taxi through the intersection.

Runway Clearance Times on 28L – West Flow (Centralized Terminal)

```
Runway Crossing Links – clearance times for aircraft on runway or on final --5/28/03
       TWY CE/E  -- 5,600' from 28L threshold (realigned for Centralized Terminal)
                    51 45 45 45 45 45 -- Arrival on Runway (by class)
                    35 35 35 35 35 35 -- Departure on Runway (by class)
                    30 30 30 30 30 30 -- Arrival on Final (by class)
       RWY 3/21  -- 5,800' from 28L threshold (realigned for Centralized Terminal)
                    55 45 45 45 45 45 -- Arrival on Runway (by class)
                    40 40 40 40 40 40 -- Departure on Runway (by class)
                    30 30 30 30 30 30 -- Arrival on Final (by class)
    28L THRESHOLD    5  5  5  5  5  5 -- Arrival on Runway (by class)
                     5  5  5  5  5  5 -- Departure on Runway (by class)
                    30 30 30 30 30 30 -- Arrival on Final (by class)
```

Question: For Runway 3/21, can we reduce the "Departure on Runway" to 35 seconds? That is, can the departure be off the runway or past the intersection by that time?

Runway Clearance Times on 28L – West Flow (Decentralized Terminal)

```
Runway Crossing Links – clearance times for aircraft on runway or on final --5/28/03
       TWY CE/E  -- 6,400' from 28L threshold (realigned for Centralized Terminal)
                    57 49 49 49 49 49 -- Arrival on Runway (by class)
                    40 40 40 40 40 40 -- Departure on Runway (by class)
                    30 30 30 30 30 30 -- Arrival on Final (by class)
       RWY 3/21  -- 6,200' from 28L threshold (realigned for Centralized Terminal)
                    57 49 49 49 49 49 -- Arrival on Runway (by class)
                    45 45 45 45 45 45 -- Departure on Runway (by class)
                    30 30 30 30 30 30 -- Arrival on Final (by class)
   28L THRESHOLD     5  5  5  5  5  5 -- Arrival on Runway (by class)
                     5  5  5  5  5  5 -- Departure on Runway (by class)
                    30 30 30 30 30 30 -- Arrival on Final (by class)
```

Question: For Taxiway CE/E, can we reduce the "Departure on Runway" to 35 seconds? For Runway 3/21, can we reduce the "Departure on Runway" to 40 seconds? That is, can the departure be off the runway or past the intersections by that time?

Note: At the next meeting, we will present values for the East Flow.

EXHIBIT 2 – OTHER MODEL INPUTS (cont)

RUNWAY DEPENDENCIES FOR SOUTHBOUND DEPARTURES ON 28L AND 28X

The Tech Center will meet with the Tower before this meeting to discuss departure-air crossover dependencies between existing runways and the new runway for **southbound props.** The following illustrates the types of questions we will ask the Tower. We hope to resolve the dependencies and describe them at this meeting. For this discussion, Box-Haulers (Cargo Feeders) are Small+ and Small aircraft, and LTPs are Large Turboprops.

Centralized Terminal -- 3 Runway Case -- Future 2 Demand

- **The potential to run triple southbound prop departures on 3 runways has a relatively small impact on the Centralized 3-runway case.**
- **Only southbound Box-Haulers would depart the new south runway. They occur between 5:30am and 8am.**
- **How would you run southbound prop departures from 3 runways -- LTP, Small+, Small? Would ATC rules permit that operation?**
- **Can you depart southbound Box-Haulers on the new south runway independently of all southbound turboprop departures on the center runway?**
- **If not, would the dependencies between those southbound props (on 28X and 28L) be identical to the ones for southbound props on the existing parallels (28L and 28R)?**
  - There are only 2 arrival runways (north runway and new south runway) during the morning, and we believe the Missed Approach Procedures for the 2 arrival runways would not be a problem for the southbound prop departures. (We assume North arrivals turn North and South arrivals turn South.)
  - **The number of operations below represent those at Future 2.** Those numbers would be lower at Future 1 and Future 1.5 demands.
  - There are only 2 southbound GA prop departures in the morning -- and they occur **between 7am and 8am. During that hour, there are 19 southbound Box-Haulers that would use the new south runway.** Even if there is a departure dependency, there are only 2 interactions at Future 2; therefore, we may not need to model that dependency. The model would not show a measurable effect on delays. If the Tower wanted those 2 GA to depart the center runway, we could easily model that.
  - There are 8 Horizon southbound Large Turboprops (LTPs) between 6am and 8am -- 3 from 6am to 7am, and 5 from 7am to 8am. They would depart on the center runway. Even if there is a dependency between those southbound LTPs and the southbound Box-Haulers, the interactions would be small and the model would show a small increase in delay. The aircraft would have different headings. A Box-Hauler would probably be released before an LTP, and the LTP would have to wait only 20 seconds. Because the model would only show a small effect on delay, it may not be necessary to model any dependencies that may exist.
  - There are 25 arrivals from 6am to 7am and 37 arrivals from 7am to 8am -- and these would be split between the 2 arrival runways. There would be fewer than 20 arrivals per runway, and no arrivals on the center runway. Arrivals would have little interaction with departures during the morning departure push.
- **After documenting the info above, we became concerned about the United Express flights -- Small+ props. There are 6 of those southbound turboprops between 6am and 7am. That makes a total of 9 southbound props on the 2 existing runways during that hour (6 from United Express and 3 from Horizon). The issue for the Tower and Tracon -- can those southbound turboprops on the center runway depart independently of the southbound Box-Haulers on the new south runway? It is the 6am to 7am hour that we are concerned about.**
- **The departure-air crossover dependencies exist for the current runways. Do we need to add them for the center runway and the new south runway? If not, why not?**
- **Do we need to add departure-air crossover dependencies for the north runway and the new south runway? Or, would you move those United Express turboprops and GA props to the center runway?**

EXHIBIT 2 – OTHER MODEL INPUTS (cont)

RUNWAY DEPENDENCIES FOR SOUTHBOUND DEPARTURES ON 28L AND 28X (cont)

Decentralized Terminal -- 3 Runway Case -- Future 2 Demand

- **The potential to run triple southbound prop departures on 3 runways has a major impact on the Decentralized 3-runway case.**
- **We already have departure-air crossover dependencies defined for the existing parallel runways for this simulation.**
- **How would you run southbound prop departures from 3 runways -- LTP, Small+, Small? Would ATC rules permit that operation?**
- **If ATC rules would permit that operation, would we need to define dependencies between southbound props on the north runway and southbound props on the new south runway?**
- **If not permitted, would you put southbound GA props and southbound United Express turboprops on the center runway? (About 50% of the GA props depart south and 22% of the United Express turboprops depart south. That means there are about 35 southbound GA props and 26 southbound United Express turboprops per day at Future 2.)**
- **24% of Horizon LTPs depart south. Therefore, 63 Horizon southbound LTPs could depart from the new south runway each day. Also, 52 southbound Box-Haulers could depart the new south runway each day. Therefore, a total of 115 aircraft could depart the new south runway each day in the Decentralized case.**
- **The departure-air crossovers are a big issue in this simulation. There would be 115 southbound props (Horizon and Box-Haulers) on the new south runway. And there would be 61 southbound props (35 GA and 26 United Express) on either the center runway or the north runway.**

RUNWAY ASSIGNMENTS FOR THE 2-RUNWAY SIMULATIONS

The Centralized and Decentralized simulations make the following assumptions:

- GA arrive and depart on 28R (including southbound departures and arrivals from the south)
- Military aircraft arrive and depart on 28L.
- Cargo and Air Carrier runway use is based on route of flight – northbound departures and arrivals from the north use 28R – southbound departures and arrivals from the south use 28L.

RUNWAY ASSIGNMENTS FOR THE 3-RUNWAY SIMULATIONS

The Centralized and Decentralized simulations make the following assumptions:

- GA arrive and depart on 28R (including southbound departures and arrivals from the south)
- Military aircraft arrive and depart on 28L.
- Cargo and Air Carrier runway use is based on route of flight – northbound departures and arrivals from the north use 28R – southbound departures and arrivals from the south use 28L. The exceptions are as follows:
  - Centralized case – southbound Box-Haulers depart on 28X.
  - Decentralized case – southbound Box-Haulers and turboprops at the Decentralized Terminal depart 28X.

EXHIBIT 3 – STATUS OF INPUTS AND TASKS

(Updated 6/19/03)

INPUTS AND TASKS	STATUS
ALPs, Improvements, Simulation Scenarios	DP3
Airline Groups and Alliances and Gate Usage—for Each Simulation Scenario	DP3
Exit Probabilities and Occupancy Times for: New Runway – Centralized & Decentralized Terminals – East & West Flows 10R/28L – Centralized Terminal (with taxiways realigned) – East & West Flows	DP3
Runway Crossing Times	DP3
Taxiway Routes for Each Simulation Scenario & Configuration—2 Runway Case Centralized & Existing Runways – East and West Flows – DP3 Decentralized & Existing Runways – East and West Flows – DP3 Centralized & New Runway – East and West Flows – DP3 Decentralized & New Runway – East and West Flows – DP3	DP3 Handout or Animation or Graphic
Taxiway Routes for Each Simulation Scenario & Configuration—3 Runway Case Centralized & Existing Runways – East and West Flows – DP3 Decentralized & Existing Runways – East and West Flows – DP3 Centralized & New Runway – East and West Flows – DP3 Decentralized & New Runway – East and West Flows – DP3	DP3 Handout or Graphic
Annual & Daily Demand	X
Fleet Mix	X
Operational Procedures & Percent Occurrence -- Simulated	X
Other Model Inputs	DP3
Annual Demand Levels (Future Demands)	X
Demand Characteristics (Future Demands)	X
Experimental Design	DP3
Simulation Results	DP3
Annual Taxi Time Savings	
Annual Number of Runway Crossings	

Note: X: The item was previously accepted and appears in Appendix B of this Data Package.
DPn: Data Package n.

2. POTENTIAL IMPROVEMENTS AND AIRPORT DIAGRAM

The Portland International Airport (PDX) Capacity Enhancement Plan Update was completed in 2001. The current Design Team was formed to evaluate the potential benefits of two terminal location alternatives – a Centralized Terminal and a Decentralized Terminal.

Exhibit 4 summarizes proposed improvements for the Airport Capacity Enhancement Plan Phase II Terminal Location Study. The potential improvements are grouped as follows:

- Airfield.
- Facilities and Equipment.
- Operational.
- User and Policy.

The proposals for this Design Team study will focus on the taxiways and new terminal locations. The Airfield Delay Simulation Model (ADSIM) and SIMMOD are capable of simulating the ground movement and the PDX departure procedures. However, ADSIM is the model of choice for modeling terminal locations, taxiway delays, and number of runway crossings. The Design Team will use ADSIM for the simulations.

Exhibit 5 lists the proposed simulation scenarios.

Exhibit 6 presents a diagram of the existing airport.

Exhibit 7 presents PDX runway configurations.

Exhibit 8 shows the modeling airfield map for the existing airport. Exhibit 9 shows the modeling airfield map with the Centralized Terminal and New Runway. Exhibit 10 shows the modeling airfield map with the Decentralized Terminal and New Runway.

The Design Team combined improvements into logical packages and reduced the required experiments to a more manageable number.

EXHIBIT 4 - POTENTIAL IMPROVEMENTS (PDX)

(Updated 3/20/03)

Airfield Improvements

SIMULATE CENTRALIZED TERMINAL.

- Without departure noise restrictions -- *All Aircraft Can Do Divergent Turns*
- With & without the 3rd parallel runway (full length,12,000' long, & 3250' south of existing 10R/28L).
- North/South Taxiway connecting the East ends of the existing parallel runways -- all demands.

SIMULATE DECENTRALIZED TERMINAL.

- Without departure noise restrictions -- *All Aircraft Can Do Divergent Turns*
- With & without the 3rd parallel runway (full length,12,000' long, & 3250' south of existing 10R/28L).
- North/South Taxiway connecting the East ends of the existing parallel runways -- all demands.

FULL-LENGTH Parallel Runway.

- **Imp (D+C1+B) in 2001 Data Pkg 7.**
- 12,000' long and 3,250' south of existing 10R/28L.
- Without departure noise restrictions.
- 3 independent arrival streams to parallel runways in VMC -- TRIPLES IN VFR1 and VFR2.
- 2 independent arrival streams to outboard runways in IMC -- (IFR1).
- North/South Taxiway connecting the East ends of the existing parallel runways -- all demands.
- North/South Taxiway connecting the East ends of the new runway to 10R/28L, with Decentralized Terminal –- all demands.

N/S taxiway connecting East ends of the existing parallel runways.

- **Imp (C) in 2001 Data Pkg 7.**
- North/South taxiway would relieve ground congestion in the East and West Flows.
- In the East Flow, it would reduce taxi times for arrivals on 10L, which are gated in Terminals A, B, and C. By enabling more arrivals to land on 10L, it would let more southbound props depart on 10R. With the existing noise restrictions, the taxiway would give controllers more flexibility in departing aircraft, especially in the West Flow.
- With no noise restrictions, departure runways could be assigned based on direction of flight rather than gate location -- especially in the West Flow.

Facilities and Equipment Improvements -- none

Operational Improvements -- none

User and Policy Improvements/Options -- none

Notes: Simulations assume simultaneous straight-in visual approaches are permitted.
Existing runways are separated by 3,100'.
FAATC notes on 1999 instrument approaches at PDX:

CAT II/III ILS:	10R
CAT I ILS:	10R/L, 28R/L
LOC/DME:	21
VOR/DME:	21, 28R
NDB or GPS:	28L
NDB:	28R

EXHIBIT 5 - SIMULATION SCENARIOS (PDX)

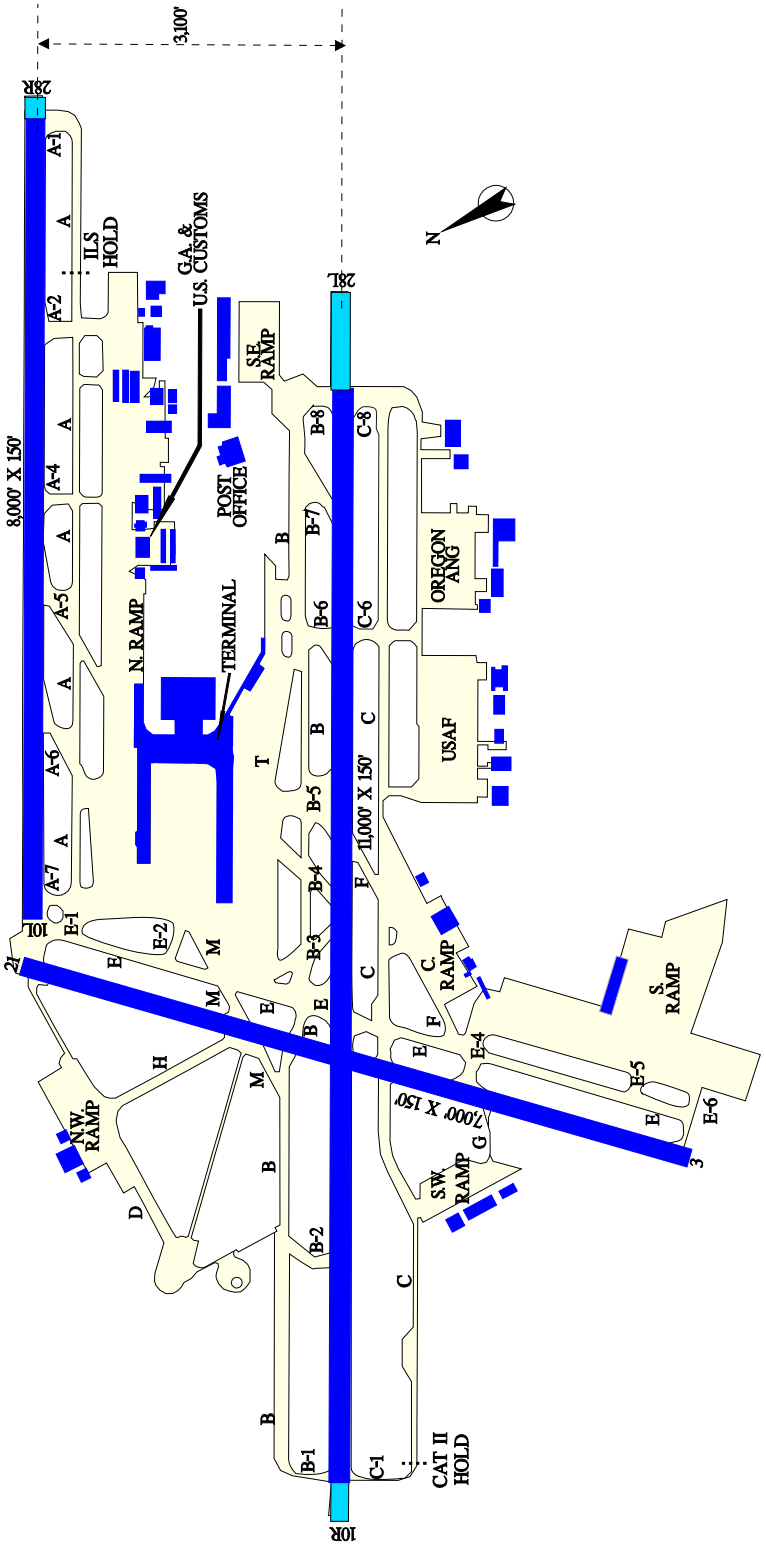
(Updated 6/20/03)

Pkg	Description of Package	Simulate at These Demand Levels F1	F1.5	F2
(A)	**Centralized Terminal & 2 Existing parallel runways** • ***No Departure Noise Restrictions (All Aircraft Can Do Divergent Turns)*** • ***N/S Twy Connecting East Ends of Existing Parallels -- all demands***	Y	Y	Y
(B)	**Decentralized Terminal & 2 Existing parallel runways** • ***No Departure Noise Restrictions (All Aircraft Can Do Divergent Turns)*** • ***N/S Twy Connecting East Ends of Existing Parallels -- all demands***	Y	Y	Y
(C)	**FULL LENGTH Parallel Runway**	Not Simulated		
(C+A)	**Centralized Terminal & Full Length Parallel Runway** • ***No Departure Noise Restrictions (All Aircraft Can Do Divergent Turns)*** • ***N/S Twy Connecting East Ends of Existing Parallels -- all demands*** • ***3 Independent Arrival Streams to Parallels in VMC -- triple approaches in VFR1/VFR2***	Y	Y	Y
(C+B)	**Decentralized Terminal & Full Length Parallel Runway** • ***No Departure Noise Restrictions (All Aircraft Can Do Divergent Turns)*** • ***N/S Twy Connecting East Ends of Existing Parallels -- all demands*** • ***N/S Twy to East Ends of New Runway – all demands*** • ***3 Independent Arrival Streams to Parallels in VMC -- triple approaches in VFR1/VFR2***	Y	Y	Y

Notes:

- **Y/N/? -- Do/Do Not/Maybe Simulate at this demand level.**
- **Model Centralized vs. Decentralized Terminal at 3 operational levels (484,000 ops, 554,000 ops, and 620,000 ops) to capture taxiway travel times and delay using ADSIM.**
  - Do-Nothing Case will not be modeled – it is not needed.
  - Model N/S Taxiway connecting East Ends of Existing Parallel Runways.
  - Model N/S taxiway connector to the new runway as an integral part of the new third parallel, with the Decentralized Terminal. (Connector is on the East Side.)
  - East and West Flows.
  - Runway delays will not be evaluated in this study.
  - VFR1 schedule (full demand) will be used to capture taxi times and runway crossings. VFR2 and IFR1 will not be simulated.
  - Measure arrival and departure taxi times, and the number of runway crossings.
  - Use 2 sink nodes for each new terminal location (Centralized, Decentralized). Military and Cargo will be relocated. If there is less than 25% difference in the terminal options, all agreed to add more nodes to the terminal configurations.
  - Runway 3/21 will be considered an operational runway with the 2-runway simulations.
  - Runway 3/21 will become a taxiway for the 3-runway simulations.
  - No Departure Noise Restrictions = Divergent Turns.
  - VFR1 and VFR2 are VMC. IFR1 is IMC.
  - **Assume 10L and Taxiway E-2 are extended for all simulations. Assume 10L extension would be constructed prior to 2010. (The Tower said Runway 3/21 is used as a taxiway 90% of the time. It is used as a runway only 10-15 days per year. Tower thought the extended E-2 should be in place for the 2-runway case and that it would also provide a benefit to PDX for the current airport.) 6/20/03**

EXHIBIT 6 - PORTLAND AIRPORT LAYOUT – EXISTING AIRFIELD

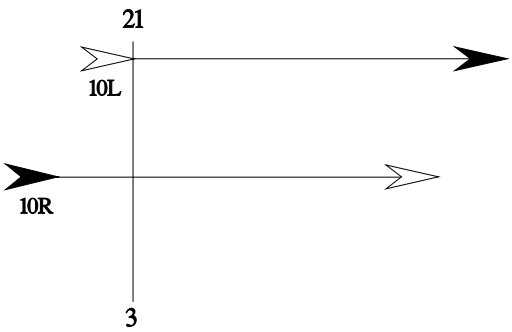


Updated 10/15/01: **Updated table to reflect the changes in Concourse C. Corrected CAT II.**
Updated 10/4/00: Exits B-3 & B-4 were added. Gate areas were updated.
Taxiway T was extended west. Hold lines were moved. Exit A-3 was removed.

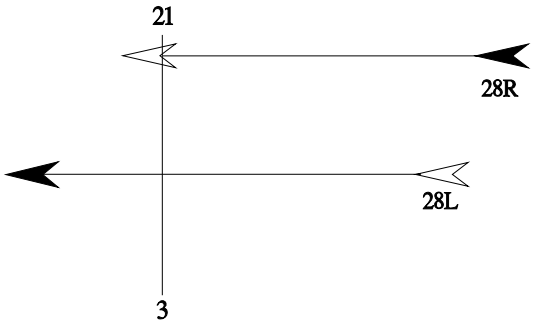
EXHIBIT 7 - RUNWAY CONFIGURATIONS

(Updated 5/13/03)

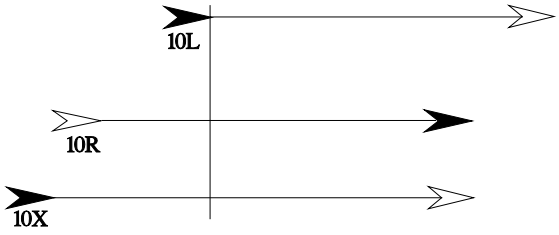
EAST VFR -- EXISTING RUNWAYS



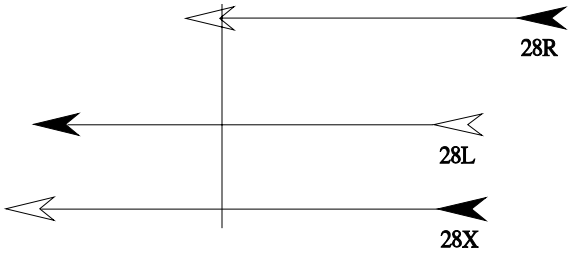
WEST VFR -- EXISTING RUNWAYS



EAST VFR -- WITH NEW RUNWAY



WEST VFR -- WITH NEW RUNWAY

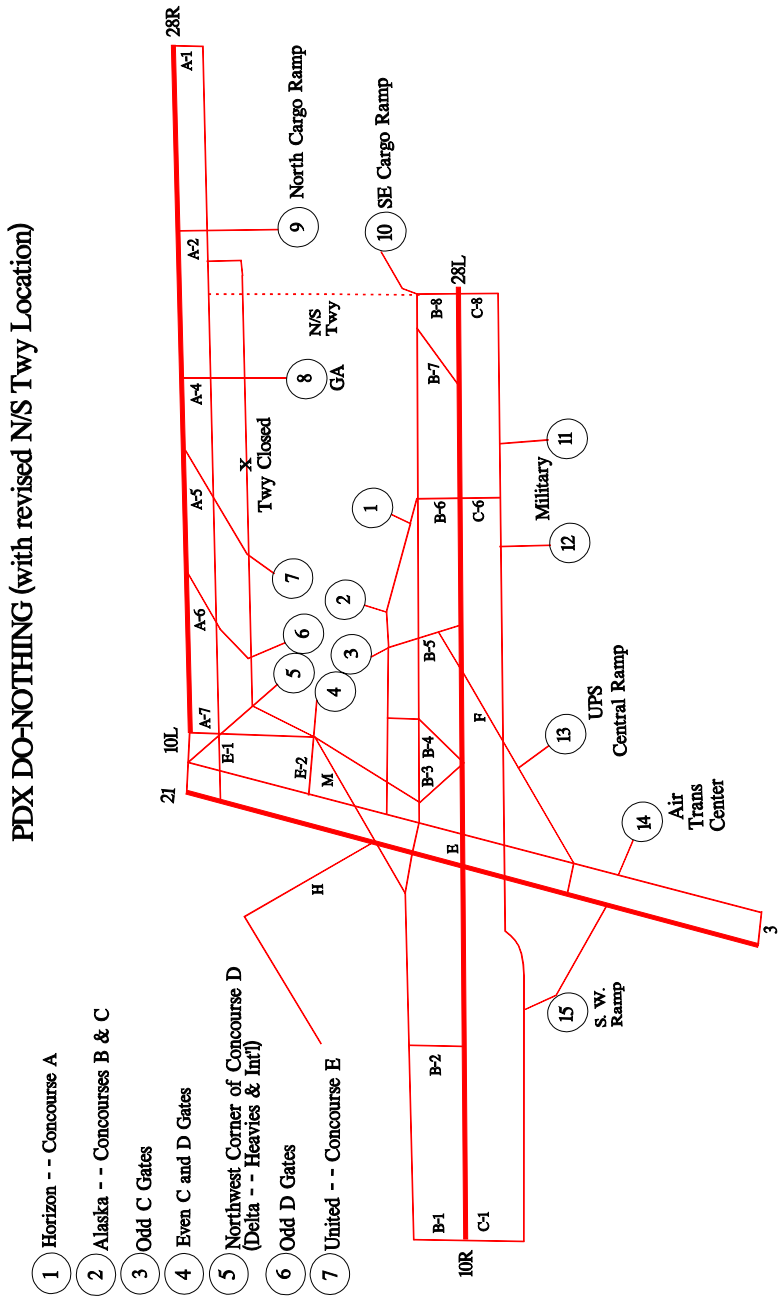


◀ = PRIMARY ARR OR DEP RUNWAY

Notes: Runway 3/21 will be considered an operational runway for the 2-runway simulations.
Runway 3/21 will become a taxiway in the 3-runway simulations.
Runway 10L/28R extenion is for departures. Arrival thresholds will probably remain the same.
The new south runway, 10X/28X, can be used for any type of arrival. No jets can depart on the runway. Only Southbound props can depart on the runway. This is due to ATC departure-air crossover issues (not noise restrictions).

EXHIBIT 8 - MODELING AIRFIELD MAP -- PDX DO-NOTHING

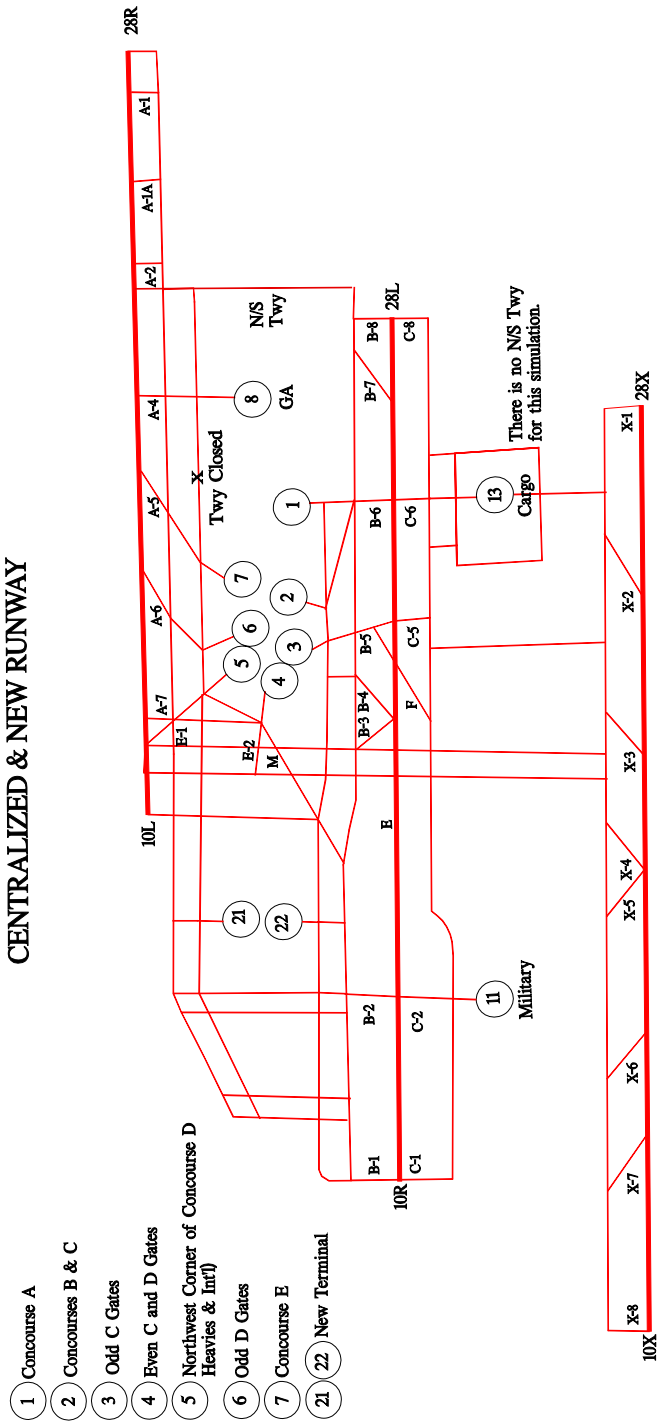
(Updated 4/16/03)



Note: The West end of Taxiway C was redrawn to be more realistic, 3/12/03.
The Do-Nothing airfield was simulated in the 2001 Design Team.
The map was corrected on 4/16/03. Primary corrections include: A7-, B-2, B-3 & B-4, and E-1. Concourses were properly named. Other corrections were cosmetic.

EXHIBIT 9 - MODELING AIRFIELD MAP – PDX WITH CENTRALIZED TERMINAL

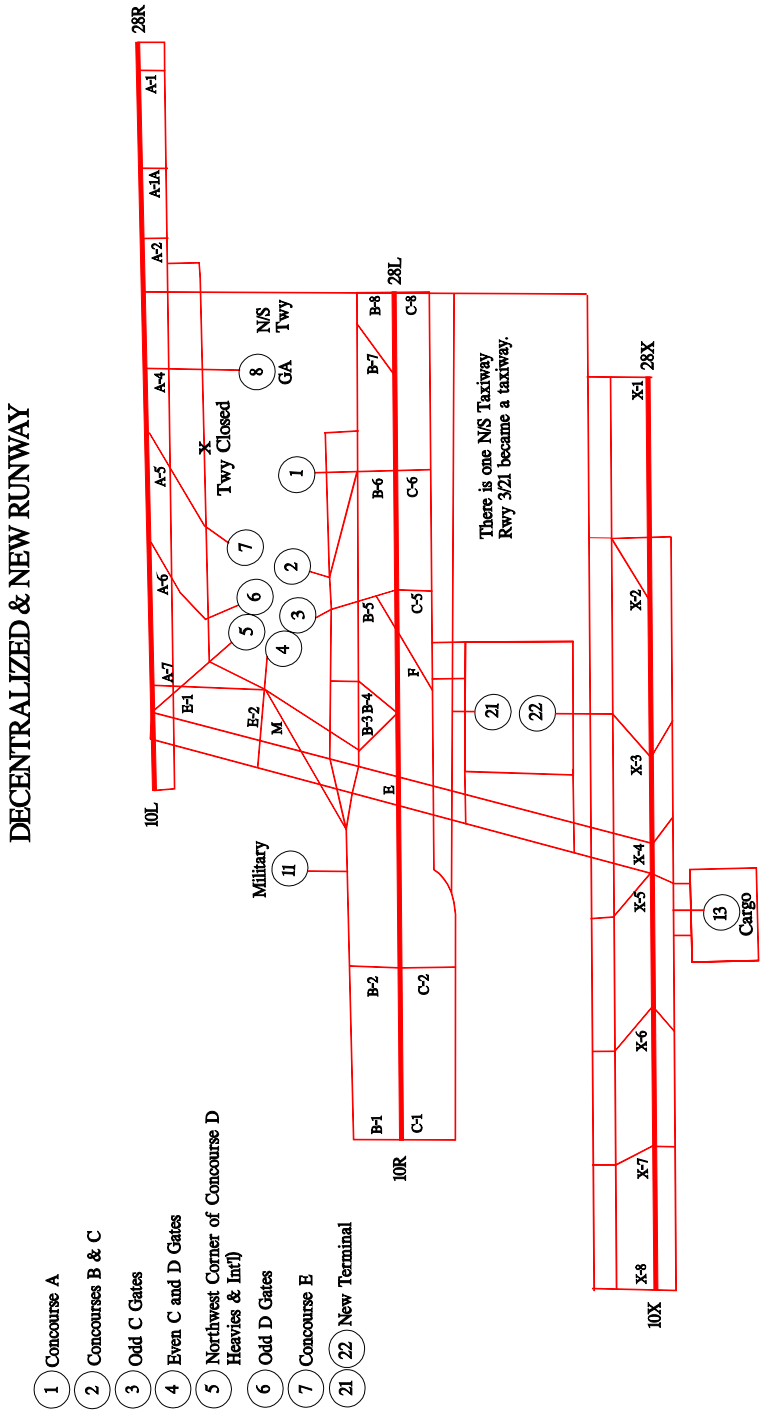
(Updated 4/16/03)



Note: This airfield will be used for the 2-runway simulations and the 3-runway simulations. **All simulations will assume that the 10L/28R and E-2 extensions are in place.** All simulations will also assume the mid-field N/S taxiways are in place and Runway 3/21 removed. 6/20/03
The map was corrected on 4/16/03. Primary corrections include: A-7, B-2, B-3 & B-4, and X-5. Concourses were properly named. Other corrections were cosmetic.

EXHIBIT 10 - MODELING AIRFIELD MAP – PDX WITH DECENTRALIZED TERMINAL

(Updated 4/16/03)



Note: This airfield will be used for the 2-runway simulations and the 3-runway simulations. **All simulations will assume that the 10L/28R and E-2 extensions are in place.** 6/20/03
The map was corrected on 4/16/03. Primary corrections include: A-7, B-2, B-3 & B-4, X-5, and X-7. Concourses were properly named. Other corrections were cosmetic.

3. ADSIM SIMULATIONS AND RESULTS

PDX Experimental Design

Exhibit 11 describes the PDX Experimental Design. The Experimental Design will consist of three demand levels (daily aircraft schedules). The Experimental Design normally includes runs for VFR and IFR simulations and for operations in both directions on each runway. For the Terminal Location Study, only the VFR1 condition will be simulated. **This study will measure the taxi travel times and number of runway crossings associated with the terminal location. Therefore, only the EAST VFR1 simulations are required to represent East Flow and only the WEST VFR1 simulations are required to represent the West Flow.**

Combining improvements into logical packages reduced the required experiments to a more manageable number.

Exhibit 12 has the preliminary results of the simulations. The runway assignments, runway clearance times, and taxiway may change.

ADSIM Calibration – Centralized and Decentralized – 2-Runway Case

The Tech Center calibrated ADSIM by simulating the airfields (with 2 runways) for the Centralized and Decentralized Terminals, using the same runway assignments as an improvement modeled in the 2001 Design Team Study -- PKG (C1+B), N/S Taxiway and All Aircraft Can Diverge. The runway assignments, aircraft separations, and runway dependencies were identical. With 2 exceptions, the gate usage was the same as the PKG (C1+B) in the 2001 Design Team Study. The calibration gate usage was as follows:

- All Air Carriers used the Existing Terminal (gates 1 – 7 on the airfield maps in this data package).
- GA used gate 8.
- However, the Military and Cargo used the gate locations on the new airfields. The Military used gate 11 and Cargo used gate 13.

The difference between these simulations and those in the 2001 study were the Military and Cargo gate locations and the use of the long form of ADSIM instead of the short form. The long form of ADSIM simulated the complete taxiway network.

The following ADSIM results were compared:

- Arrival Air Delays
- Departure Runway Queue Delays.

The daily delays in minutes were as follows:

	Arrival Air Delays	Departure Runway Queue Delays
(C1+B) N/S Twy & All Diverge – 2001 Study	3,321 minutes	7,250 minutes
Centralized Terminal (Calibration, West Flow)	3,563 minutes	6,850 minutes
Decentralized Terminal (Calibration, West Flow)	3,543 minutes	7,122 minutes

The calibration results of the Centralized and Decentralized Terminals, West Flow, compared favorably to the results of the PKG (C1+B) in the 2001 study. Some differences are due to the different locations of the Military and Cargo operations between the 2001 study and this study. Some differences are due to the use of the long form of ADSIM to simulate the airfield network in this study. These differences change the times of certain events, such as the time a departure gets to the departure threshold and departs, which change the stochastic processes.

Since the new airfields for this Design Team included the N/S Taxiway and All Aircraft Can Diverge, it was logical to compare the results with PKG (C1+B) in the 2001 study.

(A) Centralized and Existing Runways – West Flow -- Future 2 Demand

The simulation provided preliminary delays and travel times. We need to clarify the logic of the runway assignments and the values for the runway clearance times. The modeling assumed that there would be enough space on Taxiway E (realigned) for aircraft to taxi around aircraft parked at the end of Concourse C.

(B) Decentralized and Existing Runways – West Flow -- Future 2 Demand

The simulation provided preliminary delays and travel times. We need to clarify the logic of the runway assignments and the values for the runway clearance times.

Comparing Preliminary Results of Centralized and Decentralized Simulations – West Flow – 2-Runways

	CENTRALIZED – 601A (in minutes per day)	DECENTRALIZED – 611C (in minutes per day)
Arrival Air Delay	3,495	3,762
Departure Runway Queue Delay	5,491	8,658
Arrival Taxi-in Delay	124	672
Departure Taxi-out Delay	1,488	1,663
Arrival Runway-Crossing Delay	53	365
Departure Runway-Crossing Delay	19	243
Total Ground Delays – ARR & DEP	7,175	11,601
Arrival Ground Travel Time	4,602	6,571
Departure Ground Travel Time	13,980	17,904
Total Travel Times (Air & Ground) -- ARR & DEP – includes delays	22,065	28,226

Questions on N/S Taxiway and Runway Assignments:

- **For the 2-runway case, the N/S Taxiway was not used in the West Flow. All Military operations arrive and depart on 28L. All GA arrive and depart on 28R. All Cargo and Air Carrier operations are assigned by route of flight. Should the runway assignments be revised to balance arrival and departure delays between the two runways? Should southbound GA depart on 28L instead of 28R? Making these changes could increase taxi travel times and taxi delay.**

- **For the 3-runway case, the N/S Taxiway is used for southbound GA departing 28L. All GA arrive on 28R. All Military arrive and depart on 28L. All Cargo and Air Carrier operations are assigned by route of flight.**

Note: Assume Taxiway E-2 is extended for all simulations. The Tower said Runway 3/21 is used as a taxiway 90% of the time. It is used as a runway only 10-15 days per year. The Tower thought the extended E-2 should be in place for the 2-runway case and that it would also provide a benefit to PDX for the current airport. The benefit of extending E-2 can be evaluated in a Tactical Initiative at the end of this study. 6/18/03

EXHIBIT 11 - PDX EXPERIMENTAL DESIGN

(Updated 6/11/03)

		----- WEST FLOW -----	----- EAST FLOW -----	
	ADSIM SIMULATIONS	ARR = **28R**, 28L, **28X** DEP = 28R, **28L**	ARR = 10R, **10L**, **10X** DEP = **10R**, 10L	
PKG	**FUTURE 1** **484,000 ANNUAL OPS**	**47.7%**	**52.3%**	
(A)	Centralized & Existing Runways	201		
(B)	Decentralized & Existing Runways			
(C+A)	Centralized & New Runway			
(C+B)	Decentralized & New Runway			
PKG	**FUTURE 1.5** **554,000 ANNUAL OPS**	**47.7%**	**52.3%**	
(A)	Centralized & Existing Runways	401		
(B)	Decentralized & Existing Runways			
(C+A)	Centralized & New Runway			
(C+B)	Decentralized & New Runway			
PKG	**FUTURE 2** **620,000 ANNUAL OPS**	**47.7%**	**52.3%**	
(A)	Centralized & Existing Runways	**601**		
(B)	Decentralized & Existing Runways	**611**		
(C+A)	Centralized & New Runway	621		
(C+B)	Decentralized & New Runway	631		

Note: Simulate only VFR1 conditions.
Only Future 2 results for PKG (A) and PKG (B) are presented in this data package.

EXHIBIT 12 - PDX PRELIMINARY ADSIM RESULTS

DAILY DELAYS AND TRAVEL TIMES (in minutes)

(Updated 6/19/03)

			ARRIVALS					/	DEPARTURES				/ TOTAL /	**TOTAL TRAVEL TIMES**			
			FLOW	**AIR**	TAXI-IN	RWY-XNG	HOLDING	/FLOW	**RUNWAY**	TAXI-OUT	RWY-XNG	GTE-HLD	GROUND	/ARRIVAL	**ARRIVAL**	**DEPARTURE**	
EXPERIMENT #			RATE	**DELAY**	DELAY	DELAY	AREA /	RATE	**DELAY**	DELAY	DELAY	RWY-CNG	DELAYS	/AIR	**GROUND**	**GROUND**	**TOTAL**
(0)	***CALIBRATION – CENTRALIZED -- Future 2 Demand (620,000 Annual Ops)***																
531C	WEST VFR1	TOTAL	969.0	**3563.3**	196.6	.0	.0	969.0	**6850.0**	1291.6	8.7	.0	**8346.9**	3552.1	3625.4	13914.0	21091.5
(0)	***CALIBRATION – DECENTRALIZED -- Future 2 Demand (620,000 Annual Ops)***																
531C	WEST VFR1	TOTAL	969.0	**3542.6**	159.3	20.1	.0	969.0	**7122.3**	1457.8	15.9	.0	**8775.4**	3533.4	4098.8	15113.3	22745.5
(A)	***CENTRALIZED & EXISTING RUNWAYS – Future 2 Demand (620,000 Annual Ops)***																
601A	WEST VFR1	TOTAL	969.0	**3494.6**	124.2	52.8	.0	969.0	**5490.8**	1488.2	19.3	.0	**7175.3**	3483.8	**4601.7**	**13979.7**	**22065.1**
(B)	***DECENTRALIZED & EXISTING RUNWAYS – Future 2 Demand (620,000 Annual Ops)***																
611C	WEST VFR1	TOTAL	969.0	**3761.7**	672.0	364.9	.0	969.0	**8658.2**	1662.5	243.3	.0	**11600.9**	3750.3	**6571.3**	**17904.1**	**28225.8**

4. DESIGN TEAM SCHEDULE

Exhibit 13 lists the meetings concerning the completion of significant tasks, outputs, and target dates of the PDX Design Team schedule. These milestones and meetings will be held at key decision points, and will help the Design Team monitor the progress of the study.

EXHIBIT 13 - DESIGN TEAM SCHEDULE

(Updated 6/18/03)

Date	Event	Objective	Task	Responsibility	Output
11/21/02	1.	Preliminary Meeting. Review Design Team Purpose. Identify Objectives & Potential Improvements.	Review Potential Improvements & Tactical Initiatives performed in 2002. Agree on Scope of Work, Assumptions, Forecasts, & Data Requirements.	Entire Design Team.	Initial List of Potential Improvements. Agree on Study Direction.
1/15/03	2.	Collect Data	On-Site Data Collection.	Tech Center.	Establish Taxiway Routes and Parameters for Analysis.
1/16/03	3.	Kick Off Meeting. Review Design Team Purpose. Identify Objectives & Potential Improvements.	Review Data Package 1 & Potential Improvements. Agree on Scope of Work, Assumptions, Forecasts, & Data Requirements. Review & Agree on Purpose and Inputs.	Entire Design Team.	Initial List of Potential Improvements. Agree on Study Direction.
3/27/03	3.	Review Model Inputs & Potential Improvements & Airfield Layouts.	Review Data Package 2 & Potential Improvements. Establish Taxiway Routes.	Entire Design Team.	Agree on Inputs & Direction.
6/26/03	4.	Review Model Inputs & Potential Improvements & Airfield Layouts.	Review Data Package 3 & Potential Improvements. Review taxiway routes and results.	Entire Design Team.	Agree on Inputs & Direction.
/ /	?	• • •			
/ /	?	Complete & Publish Final Report.	Publish & Distribute Final Report.	FAA HQ.	Final Report.
/ /	?	Complete & Publish Summary Data Package.	Publish & Distribute Summary Data Package.	Tech Center.	Summary Data Package.

* Number of meetings and target dates are tentative and may be adjusted as progress is achieved.

APPENDIX A

MODEL INPUTS FROM 2001 DESIGN TEAM STUDY

NOTE: The PDX Tower owns a 5 NM ring around PDX.

AIRCRAFT CLASSIFICATIONS (UPDATED 8/11/00) **Accepted by PDX Team on 10/12/00**

H	**= HEAVY**	**Heavy aircraft.** Heavy aircraft weighing more than 255,000 pounds (e.g., L1011, DC10, B747, B767, DC8S, A300).
757	**= 757 B757.**	B757 only**.**
LJ	**= LARGE JET**	**Large Jets. Includes Regional Jets.** Large jet aircraft weighing more than 41,000 pounds and up to 255,000 pounds (e.g., DC9, B737, B727, MD80, CRJ).
LTP	**= LARGE TURBO PROP**	**Large Turbo Props.** Large commuter aircraft weighing more than 41,000 pounds and up to 255,000 pounds (e.g., ATR-42*, DH8, DH7, BA41*, SF34*).
S+	**= SMALL+**	**Small Commuters. Includes Business Jets.** Small commuter aircraft weighing more than 12,500 and less than 41,000 pounds (e.g., BA31, BE02, E120, LR31, LR36).
S	**= SMALL**	**Small twin & single engine props.** Small, single or twin engine aircraft weighing 12,500 pounds or less (e.g. BE58, C340, C441, AC21, BE20, C172, C210, DO27).

Notes: **For wake turbulence application, FAA Handbook 7110.65 considers LJ & LTP as "large" and S+ & S as "small".**

- * The aircraft ATR-42 and SF34 are exempt from the small category and are classified as large aircraft for separation purposes. (Source: FAA memo from ANM-531.4). They are classified as LTP (Large Turbo Prop) in this study.
- The critical factor in determining aircraft class should be approach speeds and how arrivals are separated at the point of closest approach (at threshold, except for a faster aircraft followed by a slower aircraft).
- Weights refer to maximum certified takeoff weights.
- These aircraft classes will enable us to define the model inputs more accurately and more clearly by distinguishing the key differences in operational characteristics.

Notes: **At the July 20th meeting, the Design Team agreed on the following:**

- **Regional Jets have the same departure noise procedures and prop-to-jet penalties as Large Jets. Regional Jets will be in the same class as Large Jets.**
- **Turbo Props that were treated as M (Medium) in the 1996 study will be treated as LTP (Large Turbo Props or S+ (Small+) for this study.**

LENGTH OF COMMON APPROACH (NAUTICAL MILES) -- 1996 PDX STUDY (WITH 2000 CLASSES) **Accepted by PDX Team on 10/12/00**

For the simulations, it is defined as the length of the final common approach, along which speed control *cannot* be used to separate aircraft. This differs from the 8 NM final associated with Noise Abatement procedures. The Tracon can use speed control to separate aircraft, which are at least 5 NM away from the runway end.

	Class	Heavy	757	Large Jet	LTP	Small+	Small
VFR	NM	5	5	5	5	5	3
IFR	NM	5	5	5	5	5	5

Source: 1996 PDX STUDY
Note: 10/15/01: VFR refers to VFR1 and VFR2 simulations. IFR refers to IFR1 simulations.

APPROACH SPEEDS (KNOTS) -- 1996 PDX STUDY (WITH 2000 CLASSES) **Accepted by PDX Team on 10/12/00**

The speed is given in knots for each class of aircraft flying along the common approach defined above. The standard deviation is 5 knots. The model uses three standard deviations in selecting approach speeds. Therefore, the speeds may vary by 15 knots, plus or minus.

	Class	Heavy	757	Large Jet	LTP	Small+	Small
VFR	Knots	155	140	140	130	130	110
IFR	Knots	155	140	140	130	130	110

Source: 1996 PDX STUDY (Based on Arts data for 7/20/94.)
Note: 10/15/01: VFR refers to VFR1 and VFR2 simulations. IFR refers to IFR1 simulations.

1999 PDX FLEET MIX (UPDATED 8/11/00) **Accepted by PDX Team on 10/12/00**

Aircraft Class	1999 Fleet Mix
Heavy	4.7%
B-757	5.2%
Large Jet	46.3%
Large Turbo Prop	17.6%
Small+	14.7%
Small	11.5%
TOTAL	100.0%

Source: Data provided by Port of Portland.

Notes: At the July 20, 2000 meeting, the Design Team agreed to the following:

- **Use the fleet mix presented in Data Package 1. Since that meeting, the mix was modified to reflect the change in an aircraft class definition -- Large Turbo Prop instead of Large Commuter.**
- **Regional Jets are included in the aircraft class Large Jet because they have the same departure noise restrictions, prop-to-jet penalties, approach speeds, and separations.**
- **Business Jets will be simulated as Small+/Small props, with the same departure procedures as the Small+/Small props. This was also done in the 1996 PDX Study because the percentage of Business Jets was small. Because we are limited to 6 aircraft classes in ADSIM, the Design Team agreed that it was still reasonable to treat Business Jets as Small+/Small props.**

SIMULATED DEMAND CHARACTERISTICS -- PDX **Accepted by PDX Team on 10/12/00**

ANNUAL & DAILY DEMAND

DEMAND LEVEL	ANNUAL OPERATIONS	DAILY OPERATIONS	EQUIVALENT DAYS
1999--Baseline	322,000	1,006	320
FUTURE 1	484,000	1,512	320
FUTURE 2	620,000	1,938	320

NOTE: (Annual Operations) / (Daily Operations) = Equivalent Days

PDX DEMAND CHARACTERISTICS

Annual Distribution of Traffic--(GA & MI annual ops increase according to Port's 2020 forecasts)

DEMAND	COMMERCIAL		GA		MILITARY		TOTAL	
1999-- Baseline	275,000	85.4%	38,000	11.8%	9,000	2.8%	322,000	100.0%
FUTURE 1	429,000	88.6%	45,000	9.3%	10,000	2.1%	484,000	100.0%
FUTURE 2	565,000	91.1%	45,000	7.3%	10,000	1.6%	620,000	100.0%

NOTES: **1999 distribution was based on the 1999 Port statistics.**
Commercial counts include Air Carrier, Commuter, and Air Taxis.
FAA Technical Center developed the FUTURE 1 & FUTURE 2 distributions based on the following growth assumptions of the Port's forecasts for PDX:

* FUTURE 1 represents the Port's expected forecast for 2020.
* FUTURE 2 represents the Port's high growth forecast for 2020.
* FUTURE 1 and FUTURE 2 have 45,000 annual GA operations.
* FUTURE 1 and FUTURE 2 have 10,000 annual MILITARY operations.

Daily Distribution of Traffic

DEMAND	COMMERCIAL		GA		MILITARY		TOTAL	
1999-- Baseline	860	85.5%	118	11.7%	28	2.8%	1,006	100.0%
FUTURE 1	1,342	88.8%	140	9.3%	30	2.0%	1,512	100.0%
FUTURE 2	1,768	91.2%	140	7.2%	30	1.5%	1,938	100.0%

NOTES: **Daily counts for Commercial, GA, and MI have an even number of ops per day in order to have equal numbers of arrivals and departures.**
Percentages are rounded to 1 decimal place.

SIMULATED FLEET MIXES – PDX

Accepted by PDX Team on 11/30/00

Overall -- Daily Fleet Mix by Class

H		757		LJ		LTP		S+		S		Total		
47	4.7%	52	5.2%	466	46.3%	177	17.6%	148	14.7%	116	11.5%	1,006	100.0%	Baseline
74	4.9%	80	5.3%	720	47.6%	274	18.1%	212	14.0%	152	10.1%	1,512	100.0%	Future 1
97	5.0%	106	5.5%	940	48.5%	360	18.6%	261	13.5%	174	9.0%	1,938	100.0%	Future 2

Commercial -- Daily Fleet Mix by Class

H		757		LJ		LTP		S+		S		Total		
47	5.5%	52	6.0%	444	51.7%	173	20.1%	100	11.6%	44	5.1%	860	100.0%	Baseline
74	5.5%	80	6.0%	694	51.7%	270	20.1%	156	11.6%	68	5.1%	1342	100.0%	Future 1
97	5.5%	106	6.0%	914	51.7%	356	20.1%	205	11.6%	90	5.1%	1768	100.0%	Future 2

GA -- Daily Fleet Mix by Class

H		757		LJ		LTP		S+		S		Total		
0	.0%	0	.0%	2	1.7%	0	.0%	48	40.7%	68	57.6%	118	100.0%	Baseline
0	.0%	0	.0%	4	2.9%	0	.0%	56	40.0%	80	57.1%	140	100.0%	Future 1
0	.0%	0	.0%	4	2.9%	0	.0%	56	40.0%	80	57.1%	140	100.0%	Future 2

Military -- Daily Fleet Mix by Class

H		757		LJ		LTP		S+		S		Total		
0	.0%	0	.0%	20	71.4%	4	14.3%	0	.0%	4	14.3%	28	100.0%	Baseline
0	.0%	0	.0%	22	73.3%	4	13.3%	0	.0%	4	13.3%	30	100.0%	Future 1
0	.0%	0	.0%	22	73.3%	4	13.3%	0	.0%	4	13.3%	30	100.0%	Future 2

NOTES: **Baseline Demand Characteristics developed from 1999 Port data as follows:**

Overall fleet mix – from Port data, Calendar Year 1999.
GA and MI fleet mixes -- from Port data, Calendar Year 1999.
GA fleet mix -- revised by Design Team on 10/12/00.
Commercial fleet mix -- computed from the other Baseline fleet mixes.

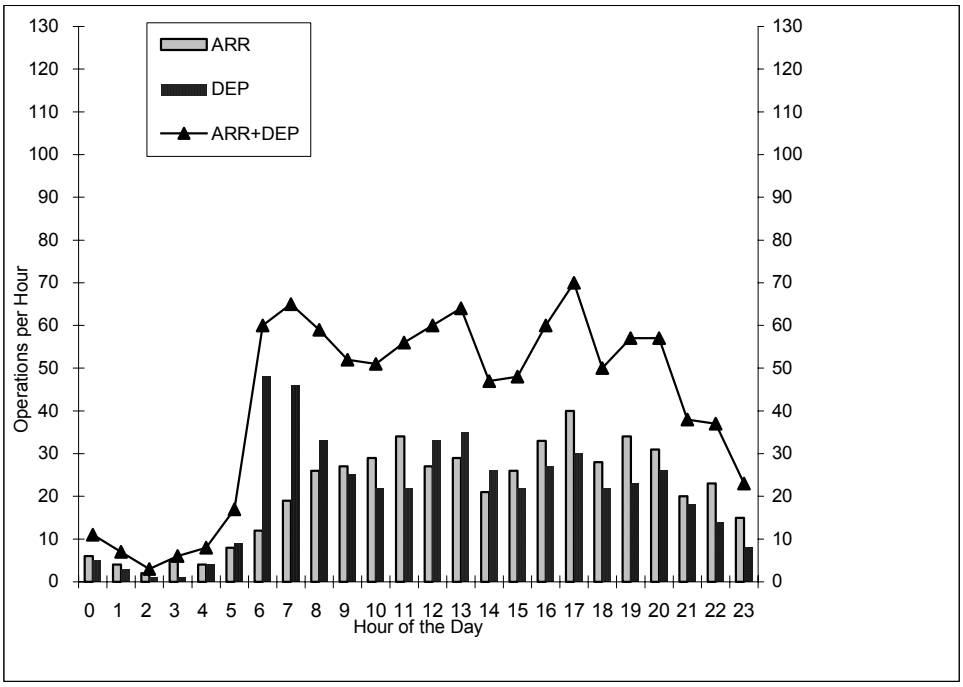
Future 1 and Future 2 Demand Characteristics developed as follows:

GA fleet mix -- same as GA fleet mix in Baseline Demand.
MI fleet mix -- same as MI fleet mix in Baseline Demand -- as close as possible.
Commercial mix – same as Commercial fleet mix in Baseline Demand.
Overall fleet mix – computed from the other fleet mixes for that future demand.

Percentages are rounded to 1 decimal place.

BASELINE DEMAND -- HOUR COUNT SUMMARY **Accepted by PDX Team on 11/30/00**

HOUR	ARR	DEP	ARR+DEP
0	6	5	11
1	4	3	7
2	2	1	3
3	5	1	6
4	4	4	8
5	8	9	17
6	12	48	60
7	19	46	65
8	26	33	59
9	27	25	52
10	29	22	51
11	34	22	56
12	27	33	60
13	29	35	64
14	21	26	47
15	26	22	48
16	33	27	60
17	40	30	70
18	28	22	50
19	34	23	57
20	31	26	57
21	20	18	38
22	23	14	37
23	15	8	23
	503	503	1006



Hour Counts -- Baseline demand

The Technical Center used the Tower Counts and OAG from Tuesday, July 27, 1999, and cargo schedules for August 2000, to develop hour counts. July 1999 was selected because it is one of the months for which we have OAG data and July is a busy month at PDX. Tuesday the 27th was selected because we wanted a good VFR1 day with low airline-reported delays obtained from CODAS (Consolidated Operations and Delay Analysis System) on APO-130's web site.
Note: 10/15/01: VFR was changed to VFR1.

We used cargo schedules for August 2000 because the cargo operators could not provide us with schedules for 1999.

We will simulate 1,006 ops at the baseline demand -- 860 air carrier (commercial), 118 GA, and 28 Military ops.

HOUR COUNTS -- 1999 DEMAND (SCD-322)

LOCAL HOUR	ARRIVALS HOUR COUNTS				DEPARTURES HOUR COUNTS				TOTAL HOUR COUNTS			
	AC	GA	MI	TOTAL	AC	GA	MI	TOTAL	AC	GA	MI	TOTAL
0	6	0	0	6	2	3	0	5	8	3	0	11
1	4	0	0	4	3	0	0	3	7	0	0	7
2	2	0	0	2	1	0	0	1	3	0	0	3
3	5	0	0	5	1	0	0	1	6	0	0	6
4	4	0	0	4	4	0	0	4	8	0	0	8
5	7	1	0	8	9	0	0	9	16	1	0	17
6	12	0	0	12	48	0	0	48	60	0	0	60
7	16	3	0	19	42	4	0	46	58	7	0	65
8	19	7	0	26	28	3	2	33	47	10	2	59
9	21	3	3	27	18	4	3	25	39	7	6	52
10	24	3	2	29	19	2	1	22	43	5	3	51
11	31	3	0	34	19	2	1	22	50	5	1	56
12	24	2	1	27	28	3	2	33	52	5	3	60
13	19	7	3	29	27	6	2	35	46	13	5	64
14	17	3	1	21	21	4	1	26	38	7	2	47
15	20	5	1	26	15	7	0	22	35	12	1	48
16	29	4	0	33	22	4	1	27	51	8	1	60
17	34	6	0	40	27	3	0	30	61	9	0	70
18	24	3	1	28	15	6	1	22	39	9	2	50
19	30	4	0	34	20	3	0	23	50	7	0	57
20	27	2	2	31	25	1	0	26	52	3	2	57
21	19	1	0	20	16	2	0	18	35	3	0	38
22	23	0	0	23	13	1	0	14	36	1	0	37
23	13	2	0	15	7	1	0	8	20	3	0	23
	430	59	14	503	430	59	14	503	860	118	28	1006

NOTES: **AC counts include Air Carrier, Commuter, and Air Taxi.**

AC -- **Tower Counts & OAG counts were supplemented to get AC counts. The counts include all cargo ops.**

GA/MI -- **The 1999 counts were based on the hourly PDX Tower counts for 7/27/99 and the cargo schedules obtained from the cargo operators.**

FUTURE 1 DEMAND **Accepted by PDX Team on 11/30/00**

HOUR COUNTS -- FUTURE 1 DEMAND (SCD-484)

LOCAL HOUR	ARRIVALS HOUR COUNTS				DEPARTURES HOUR COUNTS				TOTAL HOUR COUNTS			
	AC	GA	MI	TOTAL	AC	GA	MI	TOTAL	AC	GA	MI	TOTAL
0	9	0	0	9	3	3	0	6	12	3	0	15
1	6	0	0	6	5	0	0	5	11	0	0	11
2	3	0	0	3	2	0	0	2	5	0	0	5
3	8	0	0	8	2	0	0	2	10	0	0	10
4	6	0	0	6	6	0	0	6	12	0	0	12
5	11	1	0	12	14	0	0	14	25	1	0	26
6	19	0	0	19	75	0	0	75	94	0	0	94
7	25	4	0	29	65	5	0	70	90	9	0	99
8	30	8	0	38	44	4	3	51	74	12	3	89
9	33	4	4	41	28	5	3	36	61	9	7	77
10	38	4	2	44	30	2	1	33	68	6	3	77
11	48	3	0	51	30	2	1	33	78	5	1	84
12	37	2	1	40	44	4	2	50	81	6	3	90
13	30	8	3	41	42	7	2	51	72	15	5	92
14	27	4	1	32	33	5	1	39	60	9	2	71
15	31	6	1	38	23	8	0	31	54	14	1	69
16	45	5	0	50	34	5	1	40	79	10	1	90
17	53	7	0	60	42	4	0	46	95	11	0	106
18	37	4	1	42	23	7	1	31	60	11	2	73
19	47	5	0	52	31	4	0	35	78	9	0	87
20	42	2	2	46	39	1	0	40	81	3	2	86
21	30	1	0	31	25	2	0	27	55	3	0	58
22	36	0	0	36	20	1	0	21	56	1	0	57
23	20	2	0	22	11	1	0	12	31	3	0	34
	671	70	15	756	671	70	15	756	1342	140	30	1512

NOTES: **AC counts include Air Carrier, Commuter, and Air Taxi.**

Future 1 hour counts are 50% higher than 1999 hour counts.

As agreed upon by the Design Team, no attempt was made to smooth out hourly counts at higher demands. AC, GA, and MI maintain their own peaking characteristics.

FUTURE 2 DEMAND **Accepted by PDX Team on 11/30/00**

HOUR COUNTS -- FUTURE 2 DEMAND (SCD-620)

LOCAL HOUR	ARRIVALS HOUR COUNTS				DEPARTURES HOUR COUNTS				TOTAL HOUR COUNTS			
	AC	GA	MI	TOTAL	AC	GA	MI	TOTAL	AC	GA	MI	TOTAL
0	12	0	0	12	4	3	0	7	16	3	0	19
1	8	0	0	8	7	0	0	7	15	0	0	15
2	4	0	0	4	3	0	0	3	7	0	0	7
3	10	0	0	10	3	0	0	3	13	0	0	13
4	8	0	0	8	8	0	0	8	16	0	0	16
5	14	1	0	15	18	0	0	18	32	1	0	33
6	25	0	0	25	99	0	0	99	124	0	0	124
7	33	4	0	37	86	5	0	91	119	9	0	128
8	40	8	0	48	58	4	3	65	98	12	3	113
9	43	4	4	51	37	5	3	45	80	9	7	96
10	50	4	2	56	40	2	1	43	90	6	3	99
11	63	3	0	66	40	2	1	43	103	5	1	109
12	49	2	1	52	58	4	2	64	107	6	3	116
13	40	8	3	51	55	7	2	64	95	15	5	115
14	36	4	1	41	43	5	1	49	79	9	2	90
15	41	6	1	48	30	8	0	38	71	14	1	86
16	59	5	0	64	45	5	1	51	104	10	1	115
17	70	7	0	77	55	4	0	59	125	11	0	136
18	49	4	1	54	30	7	1	38	79	11	2	92
19	62	5	0	67	41	4	0	45	103	9	0	112
20	55	2	2	59	51	1	0	52	106	3	2	111
21	40	1	0	41	33	2	0	35	73	3	0	76
22	47	0	0	47	26	1	0	27	73	1	0	74
23	26	2	0	28	14	1	0	15	40	3	0	43
	884	70	15	969	884	70	15	969	1768	140	30	1938

NOTES: **AC counts include Air Carrier, Commuter, and Air Taxi.**

Future 2 hour counts are 28% higher than the Future 1 hour counts.

As agreed upon by the Design Team, no attempt was made to smooth out hourly counts at higher demands. AC, GA, and MI maintain their own peaking characteristics.

HOUR COUNT SUMMARY FOR 3 DEMAND LEVELS -- PDX

LOCAL HOUR	SCD-322 (1999) HOUR COUNTS			SCD-484 (FUTURE 1) HOUR COUNTS			SCD-620 (FUTURE 2) HOUR COUNTS		
	ARR	DEP	TOTAL	ARR	DEP	TOTAL	ARR	DEP	TOTAL
0	6	5	11	9	6	15	12	7	19
1	4	3	7	6	5	11	8	7	15
2	2	1	3	3	2	5	4	3	7
3	5	1	6	8	2	10	10	3	13
4	4	4	8	6	6	12	8	8	16
5	8	9	17	12	14	26	15	18	33
6	12	48	60 *	19	75	94 **	25	99	124 ***
7	19	46	65 *	29	70	99 **	37	91	128 ***
8	26	33	59	38	51	89	48	65	113
9	27	25	52	41	36	77	51	45	96
10	29	22	51	44	33	77	56	43	99
11	34	22	56	51	33	84	66	43	109
12	27	33	60 *	40	50	90 **	52	64	116 ***
13	29	35	64 *	41	51	92 **	51	64	115 ***
14	21	26	47	32	39	71	41	49	90
15	26	22	48	38	31	69	48	38	86
16	33	27	60 *	50	40	90 **	64	51	115 ***
17	40	30	70 *	60	46	106 **	77	59	136 ***
18	28	22	50	42	31	73	54	38	92
19	34	23	57	52	35	87	67	45	112
20	31	26	57	46	40	86	59	52	111
21	20	18	38	31	27	58	41	35	76
22	23	14	37	36	21	57	47	27	74
23	15	8	23	22	12	34	28	15	43
	503	503	1006	756	756	1512	969	969	1938

NOTES: **Counts include AC (Air Carrier/Commuter/Air Taxi), GA, and MI.**

1999 -- **Highest hour count is 70 -- at 5pm (1700 hrs).**
6 hours have counts of at least 60. See *.
Between 5pm and 8pm, the number of hourly ops ranges from 50 to 70.

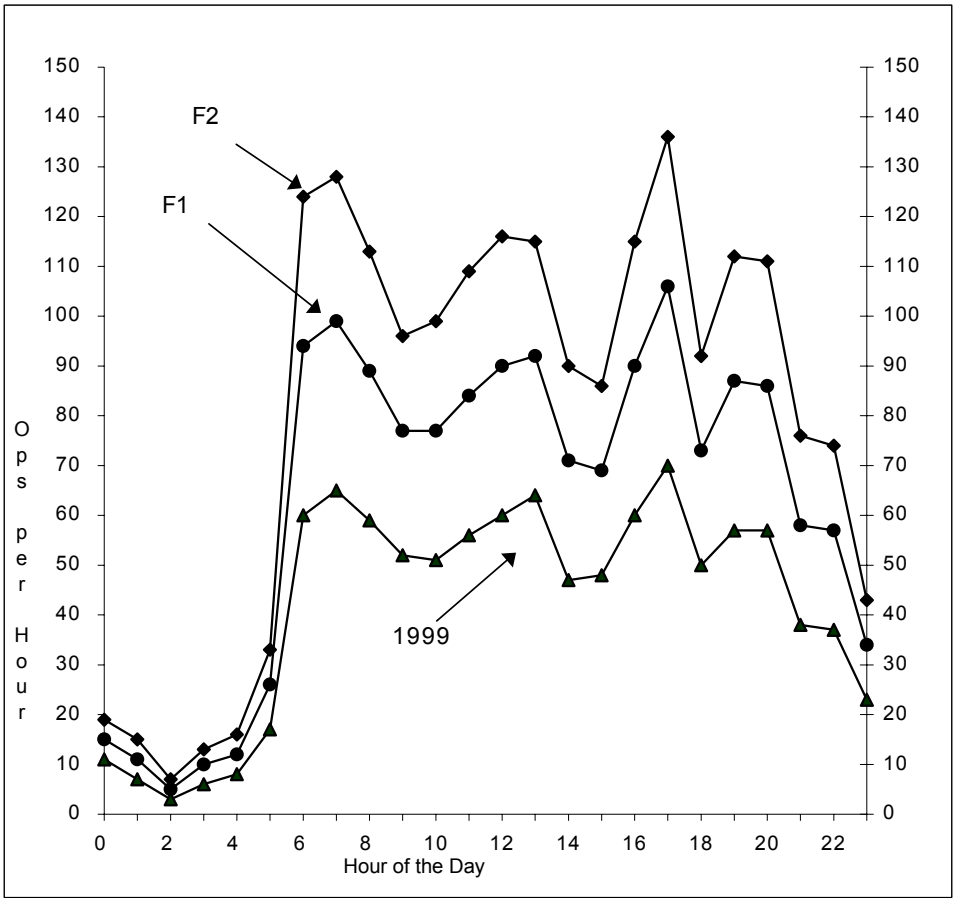
Future 1 -- **Highest hour count is 106 -- at 5pm (1700 hrs).**
6 hours have counts of at least 90. See **.
Between 5pm and 8pm, the number of hourly ops ranges from 73 to 106.

Future 2 -- **Highest hour count is 136 -- at 5pm (1700 hrs).**
6 hours have counts of at least 115. See *.**
Between 5pm and 8pm, the number of hourly ops ranges from 92 to 136.

HOUR COUNT SUMMARY **Accepted by PDX Team on 11/30/00**

PDX CHART -- HOUR COUNT SUMMARY FOR 3 DEMAND LEVELS

HOUR	1999	F1	F2
0	11	15	19
1	7	11	15
2	3	5	7
3	6	10	13
4	8	12	16
5	17	26	33
6	60	94	124
7	65	99	128
8	59	89	113
9	52	77	96
10	51	77	99
11	56	84	109
12	60	90	116
13	64	92	115
14	47	71	90
15	48	69	86
16	60	90	115
17	70	106	136
18	50	73	92
19	57	87	112
20	57	86	111
21	38	58	76
22	37	57	74
23	23	34	43
	1006	1512	1938



NOTES: **Future 1 hour counts are 50% higher than 1999 hour counts.**
Future 2 hour counts are 28% higher than the Future 1 hour counts.

As agreed upon by the Design Team, no attempt was made to smooth out hourly counts at higher demands. AC, GA, and MI maintain their own peaking characteristics.

OAG COUNTS -- July 27, 1999 **Accepted by PDX Team on 11/30/00**
CARGO COUNTS -- August 2000

OAG & CARGO COUNTS -- BY AIRLINE

Airlines (Passenger Carriers)	OAG/FAATC	FAA Code	ARR	DEP	TOTAL
Air Canada (AirBc, Ltd.)--Large Turbos	ZX	ABL	5	5	10
Alaska Airlines	AS	ASA	49	49	98
American Airlines	AA	AAL	4	2	6
America West Airlines	HP	AWE	6	6	12
Canadian Airlines (CX -- Large Turbos)	CP/CX	CDN	3	3	6
Continental Airlines	CO	COA	3	2	5
Delta Airlines (D1--HVY&Intl, DL--Other Jets)	DL/DL&D1	DAL	25	25	50
Frontier Airlines	F9	FFT	----	----	----
Hawaiian Airlines	HA	HAL	1	1	2
Horizon Airlines (HZ--Large Jets)	QX/HZ	QXE	30	30	60
Horizon Airlines (QX--Large Turbos)	QX	QXE	65	65	130
Northwest Airlines	NW	NWA	3	3	6
Reno Air	QQ	ROA	5	5	10
Skywest (DL Connection)	OO/DL	SKW/DAL	2	2	4
Skywest (UA Express) (UX--Large Turbos)	OO/UA/UX	SKW/UAL	39	39	78
Southwest Airlines	WN	SWA	31	31	62
Trans World Airlines	TW	TWA	3	3	6
United Airlines	UA	UAL	31	31	62
TOTAL PASSENGER OPS			**305**	**302**	**607**

Airlines (Cargo Carriers)	OAG/FAATC Code	FAA Code	ARR	DEP	TOTAL
Airborne Express	1F/C3	ABX	2	2	4
Ameriflight--Box-Haulers	B4	AMF	12	12	24
BAX Global / Burlington--Jets	H1/8W/C3	ATN	1	1	2
DHL Airways (via KHA in 1999)--Jets	ER/C1	DHL/KHA	1	1	2
Emery Worldwide--Jets	EB/C3	EWW	1	1	2
Federal Express--Box-Haulers	FM/B3	FDX	10	8	18
Kitty Hawk Airlines (supports DHL)--Jets	1K	KHA/DHL	----	2	2
Nippon Cargo Airlines--Jets	1N	NCA	1	----	1
UPS--Box-Haulers via Ameriflight	5X/B2	UPS	12	12	24
UPS—Jets	5X/C2	UPS	5	5	10
TOTAL CARGO OPS			**45**	**44**	**89**
GRAND TOTALS			**350**	**346**	**696**

Source: **OAG of July 27,1999 and cargo operations for August 2000. The Tech Center modified the cargo operations in order to conform to the fleet mix of the Baseline demand.**

Note: **The Tech Center added some codes to assist us in our schedule generation. We want to easily identify Large Turbo Props and Box-Haulers from the Jet operations. Therefore, we used some codes that help us; but these codes do not mean anything to the rest of the Design Team:**

- **B1, B2, B3, and B4 represent Box-Haulers by gate ramp areas: South Ramp, Central Ramp (UPS), Air Trans Center, and SW Ramp (Ameriflight), respectively.**
- **Similarly, C1, C2, C3, and C4 represent Jet operations at those ramp areas.**
- **CX, QX, UX, ZX represent Large Turbo Props for CP, QX, UA/Skywest, and ZX.**
- **HZ represents Horizon jets.**

GATE ASSIGNMENTS **Accepted by PDX Team on 10/12/00**

Airline (Passenger Carriers)	OAG Code	FAA Code	Terminal/Gates
Air Canada (AirBc, Ltd.)	ZX	ABL	E6
Alaska	AS	ASA	B2-B4, C2, C9, C13, C20-C23
American	AA	AAL	C4, C6
America West	HP	AWE	D3, D5
Canadian Airlines	CP	CDN	
Columbia Pacific	7C	COL	
Continental Airlines	CO	COA	D1,D4
Delta	DL	DAL	D5-D15
Frontier Airlines	F9	FFT	D6
Harbor Airlines	HG	HAR	A5-A12
Hawaiian Airlines	HA	HAL	D14
Horizon Air	QX	QXE	A1-A12, B4
Northwest	NW	NWA	C17, C19
Reno Air	QQ	ROA	C11
Skywest (DL Connection)	OO/DL	SKW/DAL	E7
Skywest (UA Express)	OO/UA	SKW/UAL	E6
Southwest	WN	SWA	C14-C16, C18
Trans World	TW	TWA	D2, D8
United Airlines	UA	UAL	E1-E5

Airline (Cargo Carriers)	OAG Code	FAA Code	Terminal/Gates
ABX Air, Inc.	W0	------	
Aeroflight		TTY	
Airborne Express	1F	ABX	Air Trans Center
AirPac (supports Airborne & Aeroflight)	------	APC	Air Trans Center
Ameriflight	------	AMF	South West Ramp
BAX Global (via Air Transport Intl)	H1	ATN	Air Trans Center
Burlington Air Express	8W	ASW	Air Trans Center
Cargolux Airlines (began service-2000)	S1	CLX	Air Trans Center
DHL Airways (via KHA in 1999)	ER	DHL/KHA	South Air Cargo Ramp
Emery Worldwide	EB	EWW	Air Trans Center
Empire Airlines (supports FedEx)	----	CFS	Air Trans Center
Evergreen Airlines (supports USPS)	1E	EIA	South Air Cargo Ramp
Federal Express	FM	FDX	Air Trans Center
Kitty Hawk Airlines (supports DHL)	1K	KHA/DHL	South Air Cargo Ramp
Korean Air	KE	KAL	Air Trans Center
Nippon Cargo Airlines	1N	NCA	Air Trans Center
UPS (& Box-Haulers via Ameriflight)	5X	UPS	UPS -- Central Ramp
Western Air Express (supports UPS)	----	WAE	UPS -- Central Ramp

Source: **Airlines were taken from the OAG of July 27, 1999, 2000 data collection, and the Port. Added Aeroflight (TTY) on 10/30/00.**

Comments:

- **Gate usage is based on July 1999, when PDX Terminals B & C were undergoing construction.**
- **Box-Haulers -- Ameriflight, UPS and Airborne (via Ameriflight), Federal Express (via Western Air Express).**

CARGO LOCATIONS

Accepted by PDX Team on 11/30/00
FAATC added cargo codes on 12/11/00

North Cargo Ramp:		None
South Cargo Ramp:	C1/B1	DHL (Operated by Kitty Hawk in 1999 and Reliant in 2000) Evergreen (contracted by USPS--US Postal Service) Kitty Hawk
Central Cargo Ramp:	C2/B2	UPS (& Box-Haulers via Ameriflight & Western Air Express)
Air Trans Center:	C3/B3	Airborne, AirPac, BAX, Burlington, Cargolux, Emery, Federal Express (& Box-Haulers by Empire), Korean Air, Nippon Cargo Airlines
South West Cargo Ramp:	C4/B4	Ameriflight (& Ameriflight courier Box-Haulers)

Comments:

- **Gate usage is based on July 1999, when PDX Terminals B & C were undergoing construction.**
- **Box-Haulers are Small/Small+ cargo feeders. Some Small aircraft (SW3, BE9/BE99, and BE90) were reclassified as Small+ because they are Turbo Props and cannot diverge to the North. The Box-Haulers are associated with the following cargo carriers:**
  - **Ameriflight**
  - **UPS and Airborne (via Ameriflight)**
  - **Federal Express (via Western Air Express)**
- **Box-Hauler statistics -- provided by the Port for 1999 -- updated on 11/14/00:**
  - **5:30am - 8:00am: 24 Box-Hauler Departures per day -- on average**
  - **4:30pm - 6:00pm: 23 Box-Hauler Arrivals per day -- on average**
  - **7:00pm - 8:30pm: 14 Box-Hauler Arrivals per day -- on average**
- **The number of Box-Haulers simulated is similar, but not identical, to the above numbers.**

FLEET MIX COST

Accepted by PDX Team on 6/24/01

DEMAND	**FLEET MIX COST (Direct Operating Cost per Hour) in year 2000 dollars**
1999	**$ 1,660**

NOTE:

The direct operating costs for the air carriers were for their 1st quarter 2000 costs, which were based on carrier Form 41 filings with DOT and published in *Aviation Daily*. When the 1st quarter costs were not available, the 1999 year-end costs were used. The operating costs for non-scheduled aircraft were developed using information provided by APO-110. The Technical Center used the cost for each airline and aircraft type at PDX.

AIRCRAFT GATE SERVICE TIMES — Accepted by PDX Team on 11/30/00

To simulate more realistic conditions, the departure time of a continuing arrival is adjusted to assure the aircraft meets its minimum gate service time (minimum turn-around time). These times represent the minimum time it takes to service an aircraft -- from the time it arrives at the gate until pushback. If an aircraft arrives late, the model will delay its departure in order to insure that the minimum gate service time is met.

Minimum Turn-Around Times in Minutes -- with a cumulative probability distribution

Heavy		757		LJ		LTP		S+		Small	
Min.	Cum. Prob.	Min.	Cum. Prob.	Min.	Cum. Prob.	Min.	Cum. Prob.	Min.	Cum. Prob.	Min.	Cum. Prob.
60	0.79	45	0.92	20	0.20	20	0.07	20	1.00	10	0.16
90	1.00	50	1.00	25	0.25	30	0.97			15	0.56
				30	0.50	40	1.00			20	0.64
				35	0.64					25	1.00
				40	1.00						

Source:

Heavy, 757, LJ, LTP, S+ -- Based on November 2000 values provided by the airlines serving PDX and their minimum turn-around times at PDX.

Small -- Values were from the 1996 PDX Design Team. Values for Small were weighted by percent of small-twins and small-singles in the 1996 study. The maximum gate service time at PDX was then reduced to 25 minutes (from 35 minutes). The original values for small-twins and small-singles were developed during the Newark Study (before 1990) and were used in the Charlotte, Dulles, and Cincinnati Design Team studies.

ARRIVAL AIRCRAFT LATENESS DISTRIBUTION — Accepted by PDX Team on 7/20/00

(ARRIVAL VARIABILITY DISTRIBUTION) -- 1996 PDX DESIGN TEAM STUDY

To simulate more realistic conditions, a lateness distribution (arrival variability distribution) is added to the OAG scheduled arrival time. The distribution should represent the average deviation from the scheduled arrival time, excluding delays at the destination airport (PDX).

The arrival aircraft lateness distribution is shown as a cumulative probability. For each arrival, the lateness distribution is sampled and the resulting time is added to the scheduled arrival time. This input varies the arrival time of an aircraft during each iteration of the simulation.

Amount by which actual arrival time at threshold would exceed scheduled arrival time at threshold	Distribution of aircraft lateness (cumulative %)
-20	0.0 %
-15	4.7 %
- 2	31.5 %
0	52.6 %
5	70.3 %
10	83.6 %
15	94.3 %
30	95.9 %
45	98.4 %
60	100.0 %

This table reads as follows:

0% arrive at the threshold more than 20 minutes early

4.7% (4.7% - 0%) arrive between 15 and 20 minutes early

26.8% (31.5% - 4.7%) arrive between 2 and 15 minutes early

Source: Values used in the 1994 & 1989 Seattle Design Team studies.

VFR SEPARATIONS **Accepted by PDX Team on 11/30/00**

STANDARD VFR1 (VISUAL) ARR/ARR SEPARATIONS -- AVERAGE

Report FAA-EM-78-8A -- with updated ATC separations (7110.65) for Hvy/757/S+ and PDX approach speeds
At Point of Closest Approach <<with missed approach buffer>>

ARR/ARR (NM)

LEAD	*TRAIL----*	HVY	757	LJ	LTP	S+	SM
HVY	*(7110.65--Heavy)*	4.26	5.06	5.06	4.69	5.56	5.04
757	*Treat as Heavy*	4.26	5.06	5.06	4.69	5.56	5.04
LJ	*(7110.65--Large)*	3.40	3.19	3.19	2.96	3.76	3.39
LTP	*(7110.65--Large)*	3.40	3.19	3.19	2.96	3.76	3.39
S+	*(7110.65--Small)*	3.40	3.19	3.19	2.96	2.96	3.39
SM	*(7110.65--Small)*	3.40	3.19	3.19	2.96	2.96	2.66

Expected VFR1 ARR/ARR separations for PDX: 3.4 NM 1.52 minutes
Expected VFR1 Arrival Flow Rates for PDX: 39 arrivals/runway (max thruput)

STANDARD VFR1 (VISUAL) DEP/DEP SEPARATIONS (in Minutes) -- AVERAGE

Report FAA-EM-78-8A -- with updated ATC separations (7110.65) for Hvy/757/S+

D/D (Minutes)

LEAD	*TRAIL----*	HVY	757	LJ	LTP	S+	SM
HVY	*(7110.65--Heavy)*	1.50	2.00	2.00	2.00	2.00	2.00
757	*Treat as Heavy*	1.50	2.00	2.00	2.00	2.00	2.00
LJ	*(7110.65--Large)*	1.00	1.00	1.00	1.00	1.00	0.83
LTP	*(7110.65--Large)*	1.00	1.00	1.00	1.00	1.00	0.83
S+	*(7110.65--Small)*	1.00	1.00	1.00	1.00	1.00	0.83
SM	*(7110.65--Small)*	0.83	0.83	0.75	0.75	0.75	0.58

Expected VFR1 D/D separations for PDX: 1.05 minutes
Expected VFR1 Departure Flow Rates for PDX: 57 departures/runway (max thruput) -- with no mixed ops

STANDARD VFR1 (VISUAL) DEP/ARR SEPARATIONS -- AVERAGE

Report FAA-EM-78-8A -- with updated ATC separations (7110.65) for Hvy/757/S+ and PDX approach speeds

D/A (NM)

LEAD	*TRAIL----*	HVY	757	LJ	LTP	S+	SM
HVY	*(7110.65--Heavy)*	1.68	1.52	1.52	1.41	1.41	1.19
757	*Treat as Heavy*	1.68	1.52	1.52	1.41	1.41	1.19
LJ	*(7110.65--Large)*	1.68	1.52	1.52	1.41	1.41	1.19
LTP	*(7110.65--Large)*	1.68	1.52	1.52	1.41	1.41	1.19
S+	*(7110.65--Small)*	1.68	1.52	1.52	1.41	1.41	1.19
SM	*(7110.65--Small)*	1.46	1.32	1.32	1.23	1.23	1.04

Expected VFR1 D/A separations for PDX: 1.43 NM
When departure starts to roll, arrival must be at least this far from threshold: 0.64 minutes

NOTES: VFR A/D Separations (minutes) are the Runway Occupancy Times (ROTs).
Approach Speeds in Knots: Heavy--155; 757--140; LJ --140; LTP--130; S+--130; SM--110
Expected PDX approach speed: 134 knots (2.23 NM/minute)

Notes on Sigmas:

In general, the models will vary the separations by ± 3 sigmas (standard deviations).
Separations will be within ± 1 sigma approximately 68.3% of the time.
Separations will be within ± 2 sigmas approximately 91% of the time.
Separations will be within ± 3 sigmas approximately 99.7% of the time.
ARR/ARR Standard Sigma = 18 Seconds. (Source: FAA-EM-78-8A)
Critical Function: The 18-second sigma is used to calculate the buffer, which is added to the minimum IFR separations, to generate the average IFR separations.
For a pair of arrivals, the average separation = (minimum separation in NM) + (1.65 * sigma in NM).

IFR SEPARATIONS **Accepted by PDX Team on 11/30/00**

STANDARD IFR ARR/ARR SEPARATIONS -- AVERAGE

Report FAA-EM-78-8A -- with updated ATC separations (7110.65) for Hvy/757/S+ and PDX approach speeds

At Point of Closest Approach <<with 2.5 NM minimum spacing on a Runway>>

ARR/ARR (NM)

LEAD	*TRAIL----*	HVY	757	LJ	LTP	S+	SM
HVY	*(7110.65--Heavy)*	5.29	6.16	6.16	6.07	7.07	6.91
757	*Treat as Heavy*	5.29	6.16	6.16	6.07	7.07	6.91
LJ	*(7110.65--Large)*	3.79	3.66	3.66	3.57	5.07	4.91
LTP	*(7110.65--Large)*	3.79	3.66	3.66	3.57	5.07	4.91
S+	*(7110.65--Small)*	3.79	3.66	3.66	3.57	3.57	4.91
SM	*(7110.65--Small)*	3.79	3.66	3.66	3.57	3.57	3.41

Expected IFR ARR/ARR separations for PDX: 4.15 NM 1.86 minutes

Expected IFR Arrival Flow Rates for PDX: 32 arrivals/runway (max thruput)

STANDARD IFR DEP/DEP SEPARATIONS (in Minutes) -- AVERAGE

Report FAA-EM-78-8A -- with updated ATC separations (7110.65) for Hvy/757/S+

DEP/DEP (Minutes)

LEAD	*TRAIL----*	HVY	757	LJ	LTP	S+	SM
HVY	*(7110.65--Heavy)*	1.50	2.00	2.00	2.00	2.00	2.00
757	*Treat as Heavy*	1.50	2.00	2.00	2.00	2.00	2.00
LJ	*(7110.65--Large)*	1.00	1.00	1.00	1.00	1.00	1.00
LTP	*(7110.65--Large)*	1.00	1.00	1.00	1.00	1.00	1.00
S+	*(7110.65--Small)*	1.00	1.00	1.00	1.00	1.00	1.00
SM	*(7110.65--Small)*	1.00	1.00	1.00	1.00	1.00	1.00

Expected IFR DEP/DEP separations for PDX: 1.10 minutes

Expected IFR Departure Flow Rates for PDX: 55 departures/runway (max thruput) -- with no mixed ops

STANDARD IFR DEP/ARR SEPARATIONS -- AVERAGE

Report FAA-EM-78-8A -- with updated ATC separations (7110.65) for Hvy/757/S+ and PDX approach speeds

DEP/ARR (NM)

LEAD	*TRAIL----*	HVY	757	LJ	LTP	S+	SM
ALL CLASSES		2.00	2.00	2.00	2.00	2.00	2.00

Expected IFR DEP/ARR separations for PDX: 2.00 NM

When departure starts to roll, arrival must be at least this far from threshold: 0.90 minutes

NOTES: **IFR A/D Separations (minutes) are the Runway Occupancy Times (ROTs).**
Approach Speeds in Knots: Heavy--155; 757--140; LJ --140; LTP--130; S+--130; SM--110
Expected PDX approach speed: 134 knots (2.23 NM/minute)

Notes on Sigmas:

In general, the models will vary the separations by ± 3 sigmas (standard deviations).
Separations will be within ± 1 sigma approximately 68.3% of the time.
Separations will be within ± 2 sigmas approximately 91% of the time.
Separations will be within ± 3 sigmas approximately 99.7% of the time.
ARR/ARR Standard Sigma = 18 Seconds. (Source: FAA-EM-78-8A)
Critical Function: The 18-second sigma is used to calculate the buffer, which is added to the minimum IFR separations, to generate the average IFR separations.

For a pair of arrivals, the average separation = (minimum separation in NM) + (1.65 * sigma in NM).

DEPARTURE PUSH -- 1996 PDX STUDY **Accepted by PDX Team on 7/20/00**

Departure Push = 5

Arrivals are usually given priority over departures. However, during a departure push, spacing between arrivals may be increased in order to reduce departure delay.

When five departures initiate their pushback, the Tower would space out arrivals in order to allow an aircraft to depart between two arrivals. At the current demand level, with both parallels operating, this would seldom occur. As demand increases, the Tower would increase the frequency of the departure pushes.

D/D Noise Dependency for Turboprop/Jet -- 1996 PDX STUDY **Accepted by PDX Team on 7/20/00**

VFR & IFR: 2 minutes (unless the 2 aircraft have divergent turns).

Without the noise restrictions, the standard VFR D/D separation for a Turboprop followed by a Jet would be 1 minute in VFR and 2 minutes in IFR.

With the PDX Noise restrictions, when a Turboprop departure is followed by a Jet departure, the Departure-to-Departure (D/D) separation is 2 minutes in both VFR and IFR. The additional 1-minute separation in VFR prevents the Jet from overtaking the Turboprop, which is a slower aircraft. This 2-minute separation in VFR does not apply when the Turboprop and the Jet have divergent turns.

Note: 10/15/01: VFR refers to VFR *separations*. IFR refers to IFR *separations*.

DEPARTURE RUNWAY OCCUPANCY TIMES (SECONDS) -- STANDARD (WITH 2000 CLASSES): **Accepted by PDX Team on 7/20/00**

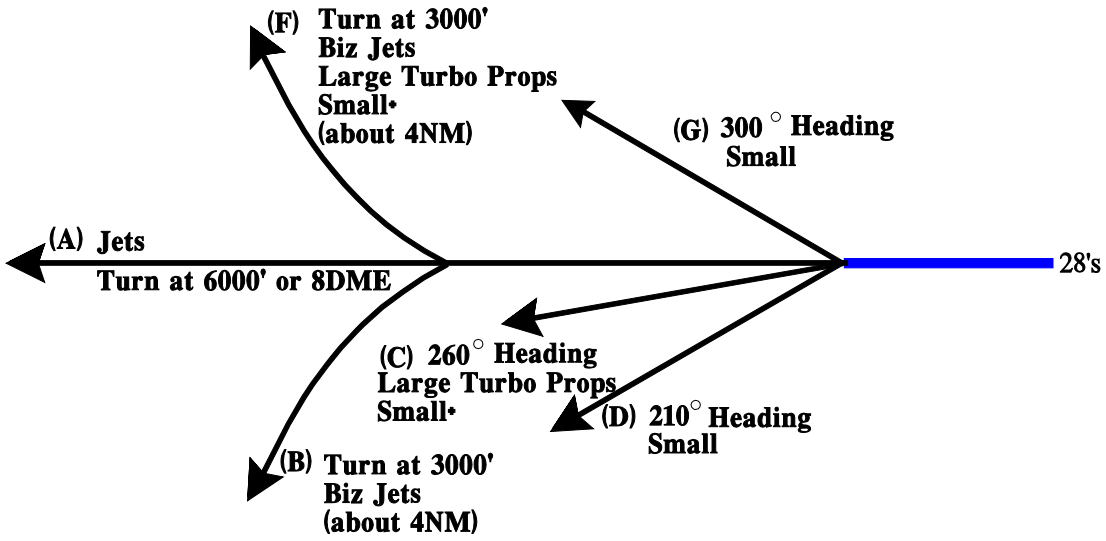
These are the minimum times a departure is on the runway. Runway crossing times and aircraft separations cannot violate these minimums.

	Class	Heavy	757	Large Jet	LTP	Small+	Small
Standard	Seconds	39	39	39	39	39	34

Source: Standard values used in all design team studies. These values were used in the 1996 PDX STUDY.

PDX NOISE DEPENDENCIES -- WEST FLOW (Same Runway) Accepted by PDX Team on 7/20/00 (Updated 8/2/00)

(B) & (C) & (D) -- Totally independent WRT noise
(A) & (C) & (D) -- Totally independent WRT noise
(C) & (D) & (G) -- Independent of everyone WRT noise
(A) South & (A) North -- Full noise dependency
(A) & (B) -- Noise Dependent up to 3000' (about 4NM from west end of runway)
(Jet / Turbine = 1 minute, Turbine / Jet = 2 minutes)
(A) & (F) -- Noise Dependent up to 3000' (about 4NM from west end of runway)
(Jet / Turbine = 1 minute, Turbine / Jet = 2 minutes)
(F) & (B) -- Noise Dependent up to 3000' (about 4NM from west end of runway)
(Jet / Turbine = 1 minute, Turbine / Jet = 2 minutes)



WEST FLOW: There are no departure fix restrictions for 2 dis-similar jets going to the same exit fix at the center. Updated 12/94.

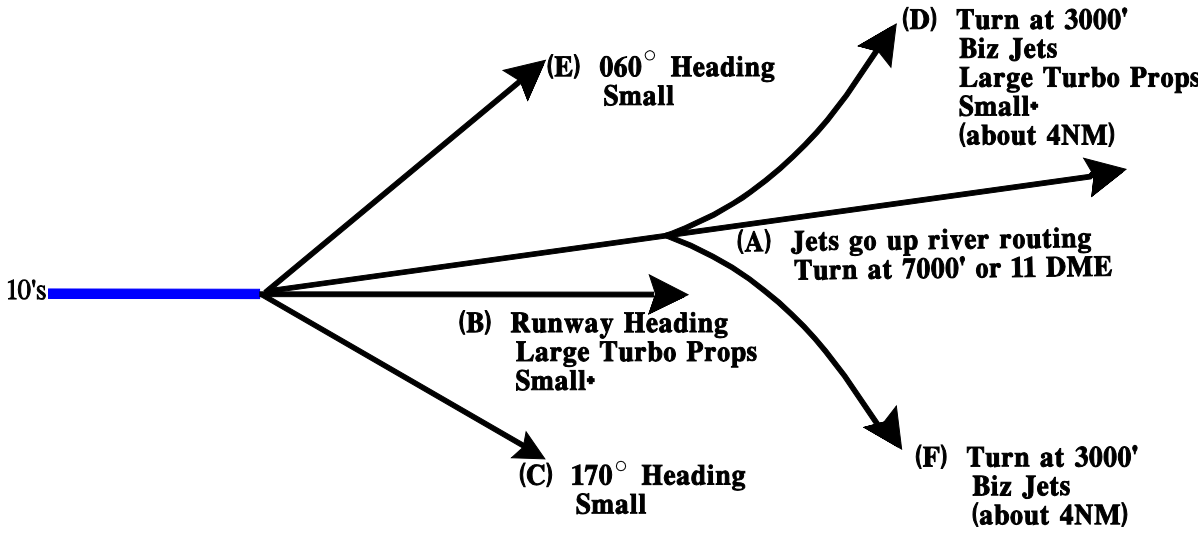
VFR FLIGHT PLAN -- Small aircraft can do an immediate turn onto any of several departure paths. Updated 12/94.

Note: Assume all Biz Jets are quiet because most are quiet.
WRT = with respect to.

Notes:
Headings for Southbound Small are now 210° (instead of 240° in 1996 Study).
Small+ aircraft follow the same heading as Large Turbo Props.
Regional Jets have the same procedures as Large Jets (A).

PDX NOISE DEPENDENCIES -- EAST FLOW (Same Runway) **Accepted by PDX Team on 7/20/00**
(Updated 8/2/00)

(A) & (B) & (C) & (E) -- Totally Independent WRT Noise
(B) & (C) & (E) -- Independent of Everyone WRT Noise
VFR Flight Plans -- No Noise Dependency
(A) South & (A) North -- Full Noise Dependency
(A) & (D) -- Noise Dependency to 3000' (about 4NM from east end of runway)
(Jet / Turbine = 1 minute, Turbine / Jet = 2 minutes)
(A) & (F) -- Noise Dependency to 3000' (about 4NM from east end of runway)
(Jet / Turbine = 1 minute, Turbine / Jet = 2 minutes)
(F) & (D) -- Noise Dependency to 3000' (about 4NM from east end of runway)
(Jet / Turbine = 1 miute, Turbine / Jet = 2 minutes)



EAST FLOW: To depart 2 dis-similar jets (when the trail aircraft is a smaller jet) going to the same exit fix at the center -- controllers must add 30 seconds to trail departure, if they cannot insert a different type of departure. However, they can usually insert a different type of departure, thereby eliminating the need to add the extra separation. Updated 12/94.

VFR FLIGHT PLAN -- Small aircraft can do an immediate turn onto any of several departure paths. Updated 12/94.

Note: Assume all Biz Jets are quiet because most are quiet.
WRT = with respect to.

Notes: **Headings for Southbound Small are now 170° (instead of 120° in 1996 Study).**
Small+ aircraft follow the same heading as Large Turbo Props.
Regional Jets have the same procedures as Large Jets (A).

OTHER DEPARTURE DEPENDENCIES **Accepted by PDX Team on 7/20/00**

D/D Rwy Dependencies due to Noise for Offset Departure Thresholds

WEST FLOW -- from 1996 PDX Study (Data Pkg 13, Appendix A, page A-14)

Departure on 28R followed by a Departure on 28L -- VFR & IFR Noise Dependency:

28R/28L

Jet/Jet:	Use 1.25 minutes (0.25 minutes added to std Jet/Jet) When Heavy is lead aircraft, add 0.25 minutes to std Heavy/Jet When 757 is lead aircraft, add 0.25 minutes to std 757/Jet
Turboprop/Turboprop:	Use 1.25 minutes (0.25 minutes added to std Turboprop/Turboprop)
Turboprop/Jet:	Use 2.00 minutes (0.00 minutes added to std Turboprop/Jet)
Jet/Turboprop:	Use 1.00 minute (0.00 minutes added to std Jet/Turboprop) When Heavy is lead aircraft, add 0.00 minutes to std Heavy/Turboprop When 757 is lead aircraft, add 0.00 minutes to std 757/Turboprop

Departure on 28L followed by a Departure on 28R -- VFR & IFR Noise Dependency:

28L/28R

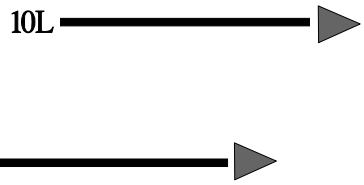
Jet/Jet:	Use 0.75 minutes (0.25 minutes subtracted from std Jet/Jet) When Heavy is lead aircraft, subtract 0.25 minutes from std Heavy/Jet When 757 is lead aircraft, subtract 0.25 minutes from std 757/Jet
Turboprop/Turboprop:	Use 0.75 minutes (0.25 minutes subtracted from std Turboprop/Turboprop)
Turboprop/Jet:	Use 2.00 minutes (0.00 minutes subtracted from std Turboprop/Jet)
Jet/Turboprop:	Use 0.75 minutes (0.25 minutes subtracted from std Jet/Turboprop) When Heavy is lead aircraft, subtract 0.25 minutes from std Heavy/Turboprop When 757 is lead aircraft, subtract 0.25 minutes from std 757/Turboprop (Adjusted format on 1/17/01)

Note: Turboprop can be LTP or S+.
Note: 10/15/01: VFR refers to VFR1 and VFR2 simulations. IFR refers to IFR1 simulations.

OTHER DEPARTURE DEPENDENCIES **Accepted by PDX Team on 7/20/00**

D/D Rwy Dependencies due to Noise for Offset Departure Thresholds

EAST FLOW -- from 1996 PDX Study (Data Pkg 13, Appendix A, page A-15)



Departure on 10R followed by a Departure on 10L -- VFR & IFR Noise Dependency:

10R/10L

Jet/Jet:	Use 2.00 minutes (1.00 minute added to std Jet/Jet) When Heavy or 757 is lead aircraft, use 2.00 minutes
Turboprop/Turboprop:	Use 2.00 minutes (1.00 minute added to std Turboprop/Turboprop)
Turboprop/Jet:	Use 2.00 minutes (0.00 minutes added to std Turboprop/Jet)
Jet/Turboprop:	Use 1.25 minutes (0.25 minutes added to std Jet/Turboprop) When Heavy is lead aircraft, add 0.25 minutes to std Heavy/Turboprop When 757 is lead aircraft, add 0.25 minutes to std 757/Turboprop

Departure on 10L followed by a Departure on 10R -- VFR & IFR Noise Dependency:

10L/10R

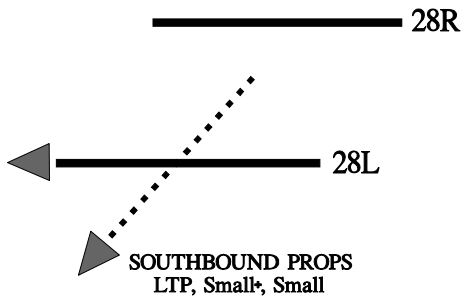
Jet/Jet:	Use 0.66 minutes (0.34 minutes subtracted from std Jet/Jet) When Heavy is lead aircraft, subtract 0.34 minutes from std Heavy/Jet When 757 is lead aircraft, subtract 0.34 minutes from std 757/Jet
Turboprop/Turboprop:	Use 0.66 minutes (0.34 minutes subtracted from std Turboprop/Turboprop)
Turboprop/Jet:	Use 2.00 minutes (0.00 minutes subtracted from std Turboprop/Jet)
Jet/Turboprop:	Use 0.66 minutes (0.34 minutes subtracted from std Jet/Turboprop) When Heavy is lead aircraft, subtract 0.34 minutes from std Heavy/Turboprop When 757 is lead aircraft, subtract 0.34 minutes from std 757/Turboprop (Adjusted format on 1/17/01)

Note: Turboprop can be LTP or S+.
Note: 10/15/01: VFR refers to VFR1 and VFR2 simulations. IFR refers to IFR1 simulations.

OTHER DEPARTURE DEPENDENCIES **Accepted by PDX Team on 11/30/00**

D/D Rwy Dependencies due to Departure Air Crossovers

WEST FLOW -- SOUTHBOUND AIR CROSSOVERS -- from 1996 PDX Study (Data Pkg 13, Appendix A, page A-10)



SOUTHBOUND PROPS (LTP or S+ or Small) departing 28R are permitted to turn south as soon as they are airborne. Therefore, there is a dependency between a southbound departure on 28R and a departure on 28L. Under the existing noise restrictions, any prop (LTP or S+ or Small) can turn south immediately.

28R/28L: Southbound Departure on 28R Followed by Departure on 28L

28R/28L		
LTP or S+ or Small/Any Aircraft:	VFR:	50 seconds for Prop to cross 28L
	IFR1:	70 seconds for Prop to cross 28L & be verified by radar

28L/28R: Departure on 28L Followed by Southbound Departure on 28R

(D/D Offsets & Separations in the 1996 Study, Data Pkg 13, Appendix A, *pages A-14 & A-22*)

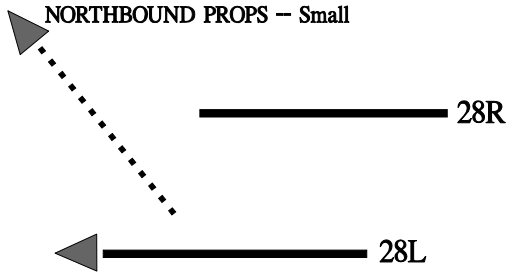
28L/28R		
Heavy or 757/LTP or S+ or Small:	VFR:	1.75 minutes (due to wake vortex & offset thresholds)
	IFR1:	1.75 minutes (due to wake vortex & offset thresholds)
		Updated 757 info on 10/30/00.
LJ/LTP or S+ or Small:	VFR:	20 seconds (due to diverging paths & offset thresholds)
	IFR1:	45 seconds (due to diverging paths & offset thresholds)
LTP or S+ northbound/LTP or S+:	VFR:	20 seconds (due to diverging paths & offset thresholds)
	IFR1:	45 seconds (due to diverging paths & offset thresholds)
LTP or S+ southbound/LTP or S+:	VFR:	45 seconds (due to offset thresholds)
	IFR1:	45 seconds (due to offset thresholds)
LTP or S+/Small:	VFR:	20 seconds (due to diverging paths & offset thresholds)
	IFR1:	45 seconds (due to diverging paths & offset thresholds)
Small/LTP or S+ or Small:	VFR:	20 seconds (due to diverging paths & offset thresholds)
	IFR1:	45 seconds (due to diverging paths & offset thresholds)

Note: 10/15/01: VFR refers to VFR1 and VFR2 simulations. IFR1 refers to IFR1 simulations.

OTHER DEPARTURE DEPENDENCIES **Accepted by PDX Team on 11/30/00**

D/D Rwy Dependencies due to Departure Air Crossovers

WEST FLOW -- NORTHBOUND AIR CROSSOVERS -- from 1996 PDX Study (Data Pkg 13, Appendix A, page A-11)



SMALL NORTHBOUND PROPS departing 28L are permitted to turn north as soon as they are airborne. Therefore, there is a dependency between a northbound departure on 28L and a departure on 28R. Under the existing noise restrictions, any Small can turn north immediately.

28R/28L: Departure on 28R Followed by Northbound Departure on 28L

(D/D Separations in the 1996 Study, Data Pkg 13, Appendix A, page A-22)

28R/28L		
Heavy or 757/Small:	VFR:	2 minutes (due to wake vortex)
	IFR1:	2 minutes (due to wake vortex) (D/D separations) **Updated 757 info on 10/30/00.**
LJ/Small:	VFR:	50 seconds (D/D separations)
	IFR1:	1 minute (D/D separations)
LTP or S+/Small:	VFR:	50 seconds (D/D separations)
	IFR1:	1 minute (D/D separations)
Small/Small:	VFR:	20 seconds (D/D separations)
	IFR1:	1 minute (D/D separations)

28L/28R: Northbound Departure on 28L Followed by Departure on 28R

28L/28R		
Small/Any Aircraft:	VFR:	50 seconds for Prop to cross 28R
	IFR1:	70 seconds for Prop to cross 28R & be verified by radar

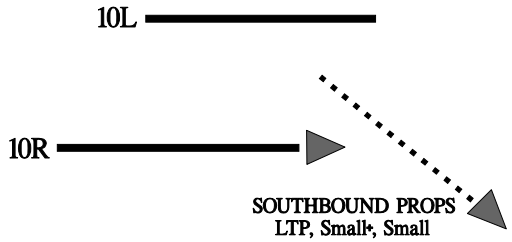
Note: Improvement Package (A), All Turbo Props and Biz Jets Can Do Divergent Turns, will permit LTP or S+ aircraft to turn north immediately. For that simulation, the separation for a LTP or S+ aircraft will be the same as that of a Small.

Note: 10/15/01: VFR refers to VFR1 and VFR2 simulations. IFR1 refers to IFR1 simulations.

OTHER DEPARTURE DEPENDENCIES **Accepted by PDX Team on 11/30/00**

D/D Rwy Dependencies due to Departure Air Crossovers

EAST FLOW -- SOUTHBOUND AIR CROSSOVERS -- from 1996 PDX Study (Data Pkg 13, Appendix A, page A-12)



SOUTHBOUND PROPS (LTP or S+ or Small) departing 10L are permitted to turn south as soon as they are airborne. Therefore, there is a dependency between a southbound departure on 10L and a departure on 10R. Under the existing noise restrictions, any prop (LTP or S+ or Small) can turn south immediately.

10L/10R: Southbound Departure on 10L Followed by Departure on 10R

10L/10R		
LTP or S+ or Small/Any Aircraft:	VFR:	50 seconds for Prop to cross 10R
	IFR1:	70 seconds for Prop to cross 10R & be verified by radar

10R/10L: Departure on 10R Followed by Southbound Departure on 10L

(D/D Offsets & Separations in the 1996 Study, Data Pkg 13, Appendix A, pages A-15 & A-22)

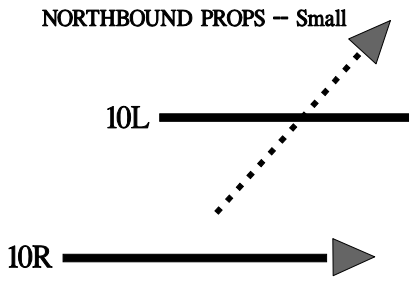
10R/10L		
Heavy or 757/LTP or S+ or Small:	VFR:	2.25 minutes (due to wake vortex & offset thresholds)
	IFR1:	2.25 minutes (due to wake vortex & offset thresholds)
		Updated 757 info on 10/30/00.
LJ/LTP or S+:	VFR:	1.25 minutes (due to offset thresholds)
	IFR1:	1.25 minutes (due to offset thresholds)
LJ/Small:	VFR:	1 minute (due to offset thresholds)
	IFR1:	1.25 minutes (due to offset thresholds)
LTP or S+ northbound/LTP or S+:	VFR:	2 minutes (due to offset thresholds)
	IFR1:	2 minutes (due to offset thresholds)
LTP or S+ southbound/LTP or S+:	VFR:	1.25 minutes (due to offset thresholds)
	IFR1:	1.25 minutes (due to offset thresholds)
LTP or S+ northbound/Small:	VFR:	2 minutes (due to offset thresholds)
	IFR1:	2 minutes (due to offset thresholds)
LTP or S+ southbound/Small:	VFR:	1.08 minutes (due to offset thresholds & diverging paths)
	IFR1:	1.25 minutes (due to offset thresholds & diverging paths)
Small northbound/Small:	N/A:	Small aircraft on 10R usually go southbound
Small southbound/Small:	VFR:	30 seconds (due to offset thresholds & diverging paths)
	IFR1:	45 seconds (due to offset thresholds & diverging paths)

Note: 10/15/01: VFR refers to VFR1 and VFR2 simulations. IFR1 refers to IFR1 simulations.

OTHER DEPARTURE DEPENDENCIES **Accepted by PDX Team on 11/30/00**

D/D Rwy Dependencies due to Departure Air Crossovers

EAST FLOW -- NORTHBOUND AIR CROSSOVERS -- from 1996 PDX Study (Data Pkg 13, Appendix A, page A-13)



SMALL NORTHBOUND PROPS departing 10R are permitted to turn north as soon as they are airborne. Therefore, there is a dependency between a northbound departure on 10R and a departure on 10L. Under the existing noise restrictions, any Small can turn north immediately.

10L/10R: Departure on 10L Followed by Northbound Departure on 10R

(D/D Offsets & Separations in the 1996 Study, Data Pkg 13, Appendix A, pages A-15 & A-22)

10L/10R		
Heavy or 757/Small:	VFR:	1.66 minutes (due to wake vortex & offset thresholds)
	IFR1:	1.66 minutes (due to wake vortex & offset thresholds) **Updated 757 info on 10/30/00.**
LJ/Small:	VFR:	20 seconds (due to offset thresholds & diverging paths)
	IFR1:	40 seconds (due to offset thresholds & diverging paths)
LTP or S+/Small:	VFR:	20 seconds (due to offset thresholds & diverging paths)
	IFR1:	40 seconds (due to offset thresholds & diverging paths)
Small/Small:	VFR:	20 seconds (due to offset thresholds & diverging paths)
	IFR1:	40 seconds (due to offset thresholds & diverging paths)

10R/10L: Northbound Departure on 10R Followed by Departure on 10L

10R/10L		
Small/Any Aircraft:	VFR:	50 seconds for Prop to cross 10L
	IFR1:	70 seconds for Prop to cross 10L & be verified by radar

Note: Improvement Package (A), All Turbo Props and Biz Jets Can Do Divergent Turns, will permit LTP or S+ aircraft to turn north immediately. For that simulation, the separation for a LTP or S+ aircraft will be the same as that of a Small.

Note: 10/15/01: VFR refers to VFR1 and VFR2 simulations. IFR1 refers to IFR1 simulations.

OTHER DEPARTURE DEPENDENCIES — Accepted by PDX Team on 10/12/00

Additional IFR1 Dependencies due to Departure Air Crossovers

A/D IFR1 Runway Dependencies due to Departure Air Crossovers

-- from 1996 PDX Study (Data Pkg 13, Appendix A, page A-9)

In IFR1, there is an additional runway dependency for an aircraft departing the north runway, turning south, and crossing over the south runway. The arrival on the south runway must have landing assured before the southbound departure can be released.

Similarly, in IFR1, there is an additional runway dependency for an aircraft departing the south runway, turning north, and crossing over the north runway. The arrival on the north runway must have landing assured before the southbound departure can be released.

Arrival/Departure Turning and Crossing the Arrival Runway

South Runway/North Runway:	IFR1:	5 seconds (for arrival to have landing assured)
North Runway/South Runway:	IFR1:	5 seconds (for arrival to have landing assured)

D/A IFR1 Runway Dependencies due to Departure Air Crossovers

-- from 1996 PDX Study (Data Pkg 13, Appendix A, page A-9)

In IFR1, there is an additional runway dependency for an aircraft departing the north runway, turning south, and crossing over the south runway. The arrival on the south runway must be at least 2 NM in-trail behind the southbound departure when the southbound departure is released.

Similarly, in IFR1, there is an additional runway dependency for an aircraft departing the south runway, turning north, and crossing over the north runway. The arrival on the north runway must be at least 2 NM in-trail behind the departure when the northbound departure is released.

The D/A separation of 2 NM must be adjusted to reflect the offsets of the runway thresholds.

Departure/Arrival (when departure turns and crosses the arrival runway)

28R/28L:	IFR1:	2.3 NM (distance of arrival from its threshold) (2 NM + 0.3 NM offset)
28L/28R:	IFR1:	1.7 NM (distance of arrival from its threshold) (2 NM - 0.3 NM offset)
10R/10L:	IFR1:	2.9 NM (distance of arrival from its threshold) (2 NM + 0.9 NM offset)
10L/10R:	IFR1:	1.1 NM (distance of arrival from its threshold) (2 NM - 0.9 NM offset)

Note: These A/D and D/A dependencies protect *for* a missed approach.
Note: 10/15/01: IFR1 refers to IFR1 simulations.

IFR1 -- Staggered Approaches to Parallel Runways with Offset Thresholds (from PDX 1996 Study) **Accepted by PDX Team on 2/1/01**

In IFR1, PDX conducts staggered approaches to the parallel runways. PDX must use at least a 1.5 NM stagger. To insure that minimum separations are not violated, a 2 NM longitudinal stagger will be simulated. Because the thresholds are offset, we will simulate the stagger as follows:

Arrival/Arrival

28R/28L:	IFR1:	2.3 NM (distance of trailing arrival from its threshold) (2 NM + 0.3 NM offset)
28L/28R:	IFR1:	1.7 NM (distance of trailing arrival from its threshold) (2 NM - 0.3 NM offset)
10R/10L:	IFR1:	2.9 NM (distance of trailing arrival from its threshold) (2 NM + 0.9 NM offset)
10L/10R:	IFR1:	1.1 NM (distance of trailing arrival from its threshold) (2 NM - 0.9 NM offset)

Note: 10/15/01: IFR1 refers to IFR1 simulations.

OPERATIONAL PROCEDURES AND MINIMA -- DEFINITIONS **Accepted by PDX Team on 11/30/00**

These were developed from the 1996 PDX Study -- based on the PDX Airside Capacity Study (final report), March 1991, pgs A-9 thru A-13. They were revised in July 2000 to reflect current conditions and assumptions:

- **1.5 NM staggered approaches to parallel runways in IFR for Do-Nothing case.**
- **Runway 3 will not be used for arrivals**. Current ATC rules for LAHSO (Land and Hold Short Operations) have such severe restrictions that they effectively do not permit simultaneous arrivals to Runway 3 and 10R/28L.

VFR1: Ceiling ≥ 3,500' *and* Visibility ≥ 10 miles.
Visual (VFR1) separations.
Simultaneous visual approaches to both parallel runways by all aircraft types.
Runway 3 not used for arrivals in VFR1.
Although not permitted under noise abatement procedures, ATC rules would permit certain small aircraft to make visual **dependent** approaches to Runway 3. Current LAHSO rules do not permit small aircraft to make simultaneous approaches to Runway 3 and 10R/28L, even when the runways are dry and there is no tailwind.

VFR2: Less than VFR1, *and*, Ceiling ≥ 2,000' *and* Visibility ≥ 5 miles.
IFR separations for A/A. Visual (VFR1) separations for others.
Simultaneous approaches may be permitted to the parallel runways.
10/26/95 Update: Small_as_Trail can use Visual A/A separations.
Runway 3 not used for arrivals in VFR2.
ATC rules would permit certain small aircraft to make **dependent** approaches to Runway 3 when the runways are dry. VFR2 usually occurs in the winter when the runways are wet. In addition, current LAHSO rules do not permit small aircraft to make simultaneous approaches to Runway 3. In reality, Runway 3 cannot and would not be used for arrivals in VFR2.

IFR1: Less than VFR2, *and*, Ceiling ≥ 200' *and* Visibility ≥ 0.5 miles.
IFR separations are required.
1.5 NM staggered approaches to existing parallel runways in West and East flows.
Visual approaches are not allowed to any runway.

IFR2: Less than IFR1, *and*, Ceiling ≥ 100' *and* Visibility ≥ 0.25 miles.
IFR separations. Arrive on 10R. Depart on 10R & 10L.

IFR3: Visibility < 0.25 miles *and* ≥ 0.125 miles.
IFR separations. Arrive on 10R. Depart on 10R & 10L.
SMGCS is expected in Fall 2001. The expected departure minimums are 300' RVR for SMGCS participants and 500' RVR for all others. **Updated 1/18/01.**

Minimums obtained from approach plates:

- **10R: CAT I minimums are 200'AGL and 3/8 mile.**
- **10L: CAT I minimums are 450' AGL and 1 mile.**
- **28R: CAT I minimums are 300 AGL and 1 mile. Updated 10/30/00.**
- **28L: CAT I minimums are 400' AGL and 1/2 mile. Updated 10/30/00.**

OPERATIONAL PROCEDURES AND MINIMA -- SIMULATED (UPDATED 8/11/00) **Accepted by PDX Team on 10/12/00**

At the July 20, 2000 meeting, the Design Team agreed it was reasonable to use the values from the 1996 PDX Study. With the addition of the new tower and CAT I ILS approaches to 10R and 28L, the minimums changed from 1996 minimums. However, the Design Team agreed that the percentages of VFR1, VFR2, and IFR1 were still reasonable to use in the annual delay calculations.

Weather	VFR1	VFR2	IFR1	
MINIMA	VISUAL	<VIS & ≥IFR	CAT I	ALL WEATHER
Ceiling:	3500'	2000'	200'	
Visibility:	10 miles	5 miles	0.5 miles	
EAST FLOW (10s)	35.3%	9.2%	7.8%	52.3%
WEST FLOW (28s)	39.1%	5.0%	3.6%	47.7%
	-----	-----	-----	-----
TOTAL	74.4%	14.2%	11.4%	100.0%

Note: 10/15/01: VFR1 and VFR2 are VMC. IFR1 is IMC.
10/15/01: VFR1, VFR2, and IFR1 refer to simulated procedures/conditions.

1996 PDX Study -- PDX Tower:

- All aircraft usually do or can operate in IFR1 & IFR2.
- Fog usually occurs from sunrise to 10am.
- VFR3 is not needed.
- VFR2 usually occurs in full days; thus, the VFR2 Factor = 1.
- IFR1 usually occurs in full days; thus, the IFR1 Factor = 1.

1996 PDX Study -- Design Team:

- At the January 18, 1995 meeting, the Design Team agreed to simulate only VFR1, VFR2, and IFR1 based on the list of improvements.
- The Technical Center compared the Port of Portland's 4 years of runway use data (1990-1993), presented at the May 1995 meeting, to the 10 years of runway use data (1979-1988) summarized above. For all weather conditions, both sets of data showed the East Flow usage was 52.3% and the West Flow usage was 47.7%. At the July 1995 meeting, the Design Team agreed to use the above values, *Operational Procedures and Runway Utilization Simulated*, for the SIMMOD annualizations**.**

RUNWAY EXIT DATA -- 1996 STUDY (WITH 2000 CLASSES) Accepted by PDX Team on 10/12/00 (UPDATED 8/11/00)

Note: At the July 20th meeting, the Design Team agreed to use the 1996 exit data for this study. The tables were updated to reflect the changes in the aircraft class definitions.

Runway 10R -- 1996 PDX STUDY (With 2000 Classes)

Exit / Distance	E 4600'	---	B5/F 6900'*	B6/C6 8500'	TOTAL	
Heavy Usage			70%	30%	100%	Adjusted by
ROT			53	64	56 sec	Tower & FAATC 12/94
757 Usage	17%		81%	2%	100%	
ROT	40		53	64	51 sec	
Large Jet Usage	17%		81%	2%	100%	
ROT	40		53	64	51 sec	
LTP Usage	41%		54%	5%	100%	LTP treated
ROT	40		55	57	49 sec	as Medium in 1996 Study
Small+ Usage	41%		54%	5%	100%	Small+ treated
ROT	40		55	57	49 sec	as Medium in 1996 Study
Small Usage	93%		7%		100%	
ROT	47		60		48 sec	

Notes: Distance in feet from threshold. Conditions were VFR and dry. Observed by PDX Tower.
Exits B3/B4 have been added about 5,600' from the 10R threshold.
Most of the 2000 data collection had a key taxiway closed that affected exit usage.
At the July 2000 meeting, the Design Team agreed to use the 1996 exit data for this study.

Runway 10L -- 1996 PDX STUDY (With 2000 Classes)

Exit / Distance	A5 3400'rhs	A4 4200'	A2/A3 5900'*	A1/END 8000'	TOTAL	
Heavy Usage			80%	20%	100%	
ROT			51	65	54 sec	
757 Usage	5%	5%	74%	16%	100%	
ROT	37	37	51	65	52 sec	
Large Jet Usage	5%	5%	74%	16%	100%	
ROT	37	37	51	65	52 sec	
LTP Usage	28%	50%	22%		100%	LTP treated
ROT	37	42	58		44 sec	as Medium in 1996 Study
Small+ Usage	28%	50%	22%		100%	Small+ treated
ROT	37	42	58		44 sec	as Medium in 1996 Study
Small Usage	16%	84%			100%	
ROT	42	47			46 sec	

Notes: Distance in feet from threshold. Conditions were VFR and dry. Observed by PDX Tower.

Legend:
% - Exit Utilization (percent)
s - Runway Occupancy Time (seconds)
h - High Speed Exit (angled exit)
rhs - Reverse High Speed Exit (reverse angled exit)
* - Combination of h, rhs, and 90° exits

Runway 28R -- 1996 PDX STUDY (With 2000 Classes)

Exit Distance	A2/A3 2100’	A4 3800’	A5 4600’hs	A6 5900’hs	A7/END 8000	TOTAL	
Heavy Usage				80%	20%	100%	
ROT				44	63	48 sec	
757 Usage		1%	21%	60%	18%	100%	
ROT		35	39	44	63	46 sec	
Large Jet Usage		1%	21%	60%	18%	100%	
ROT		35	39	44	63	46 sec	
LTP Usage		27%	64%	9%		100%	LTP treated
ROT		37	41	50		41 sec	as Medium in 1996 Study
Small+ Usage		27%	64%	9%		100%	Small+ treated
ROT		37	41	50		41 sec	as Medium in 1996 Study
Small Usage	5%	84%	11%			100%	
ROT	24	43	42			42 sec	

Notes: Distance in feet from threshold. Conditions were VFR and dry. Observed by PDX Tower.
ADSIM links for the 28R exits are 311 through 315. 1/11/01--FAATC.
For the NEW RUNWAY, ADSIM will use 28R occupancy times and probabilities. 1/11/01-- FAATC.
ADSIM links for the NEW RUNWAY exits are 331 through 335. 1/11/01--FAATC.

Runway 28L -- 1996 PDX STUDY (With 2000 Classes)

Exit Distance	B6/C6 2500’	B5/F 4100’*	CE/E 6400’	B2 8500’	TOTAL	
Heavy Usage			80%	20%	100%	
ROT			57	61	58 sec	
757 Usage		18%	80%	2%	100%	
ROT		39	49	61	47 sec	
Large Jet Usage		18%	80%	2%	100%	
ROT		39	49	61	47 sec	
LTP Usage	18%	78%	4%		100%	LTP treated
ROT	31	40	60		39 sec	as Medium in 1996 Study
Small+ Usage	18%	78%	4%		100%	Small+ treated
ROT	31	40	60		39 sec	as Medium in 1996 Study
Small Usage	12%	80%	8%		100%	
ROT	34	42	48		42 sec	

Notes: Distance in feet from threshold. Conditions were VFR and dry. Observed by PDX Tower.
Exits B3/B4 have been added about 5,400' from the 28L threshold.
Most of the 2000 data collection had a key taxiway closed that affected exit usage.
At the July 2000 meeting, the Design Team agreed to use the 1996 exit data for this study.
ADSIM links for the 28L exits are 321 through 324. 1/11/01--FAATC.

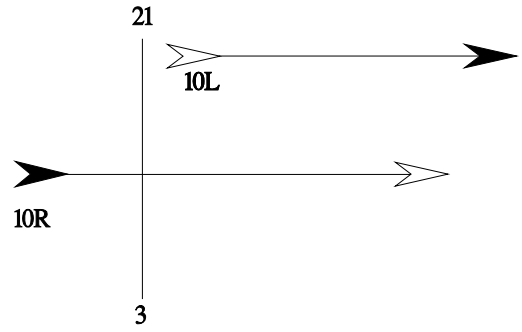
Runway 3 -- Runway 2 in 1996 PDX STUDY (With 2000 Classes)

Exit Distance	E4 2200’	C/CE 3100’	B 4400’	M 4800’hs	TOTAL	
LTP Usage			50%	50%	100%	LTP treated
ROT			45	47	46 sec	as Medium in 1996 Study
Small+ Usage			50%	50%	100%	Small+ treated
ROT			45	47	46 sec	as Medium in 1996 Study
Small Usage	75%	25%			100%	
ROT	34	43			36 sec	

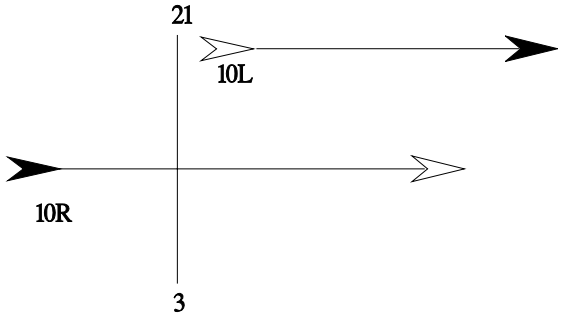
Notes: Distance in feet from threshold. Conditions were VFR and dry. Observed by FAATC.

FROM SUMMARY DATA PACKAGE – Runway Configurations (PDX Do-Nothing)–October 2001

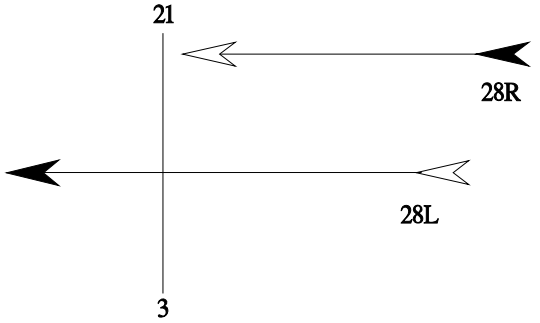
EAST VFR1 & VFR2



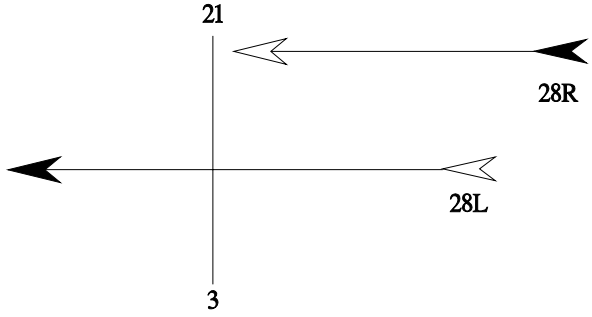
EAST IFR1



WEST VFR1 & VFR2



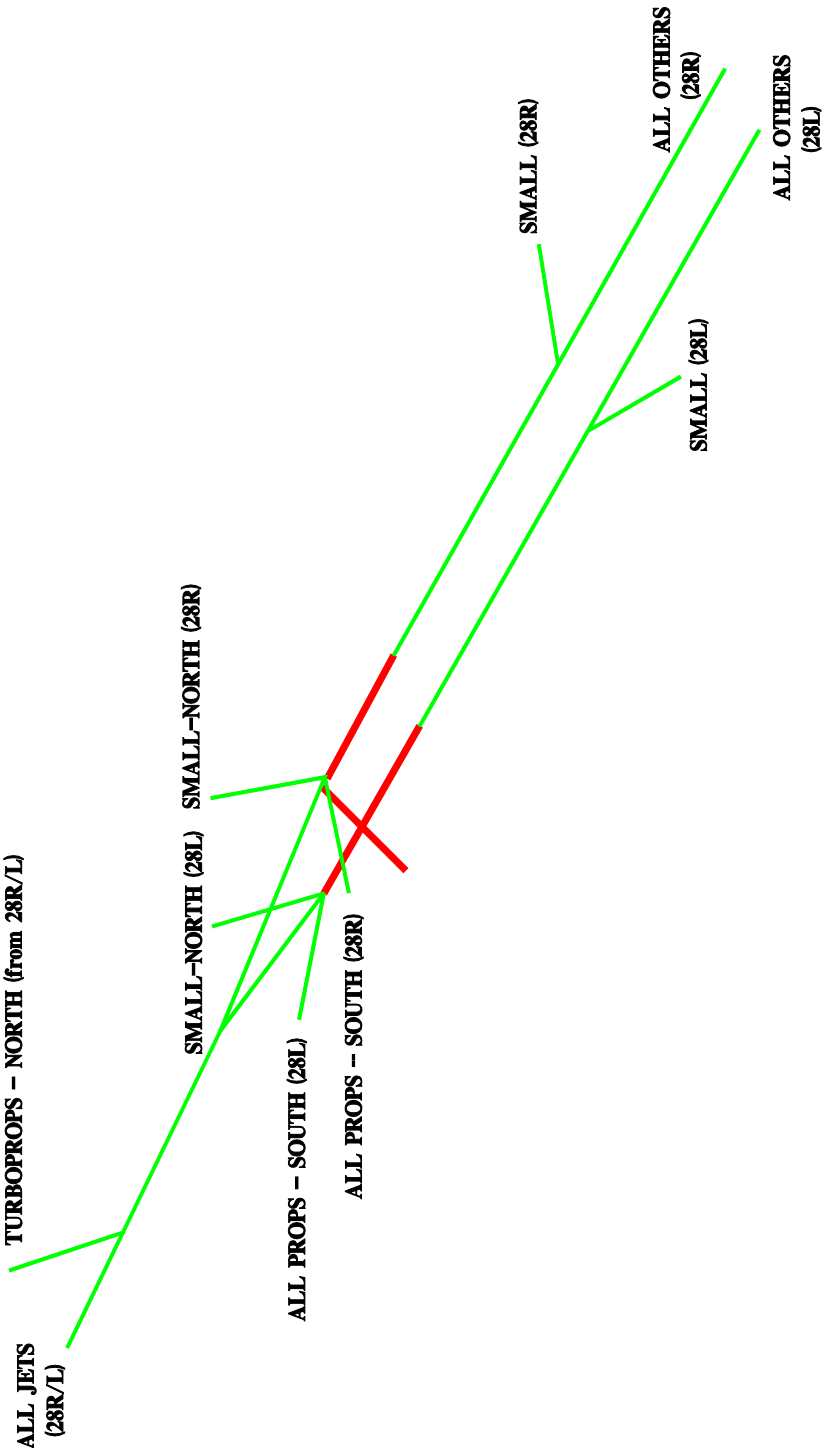
WEST IFR1



◄ = PRIMARY ARR OR DEP RUNWAY

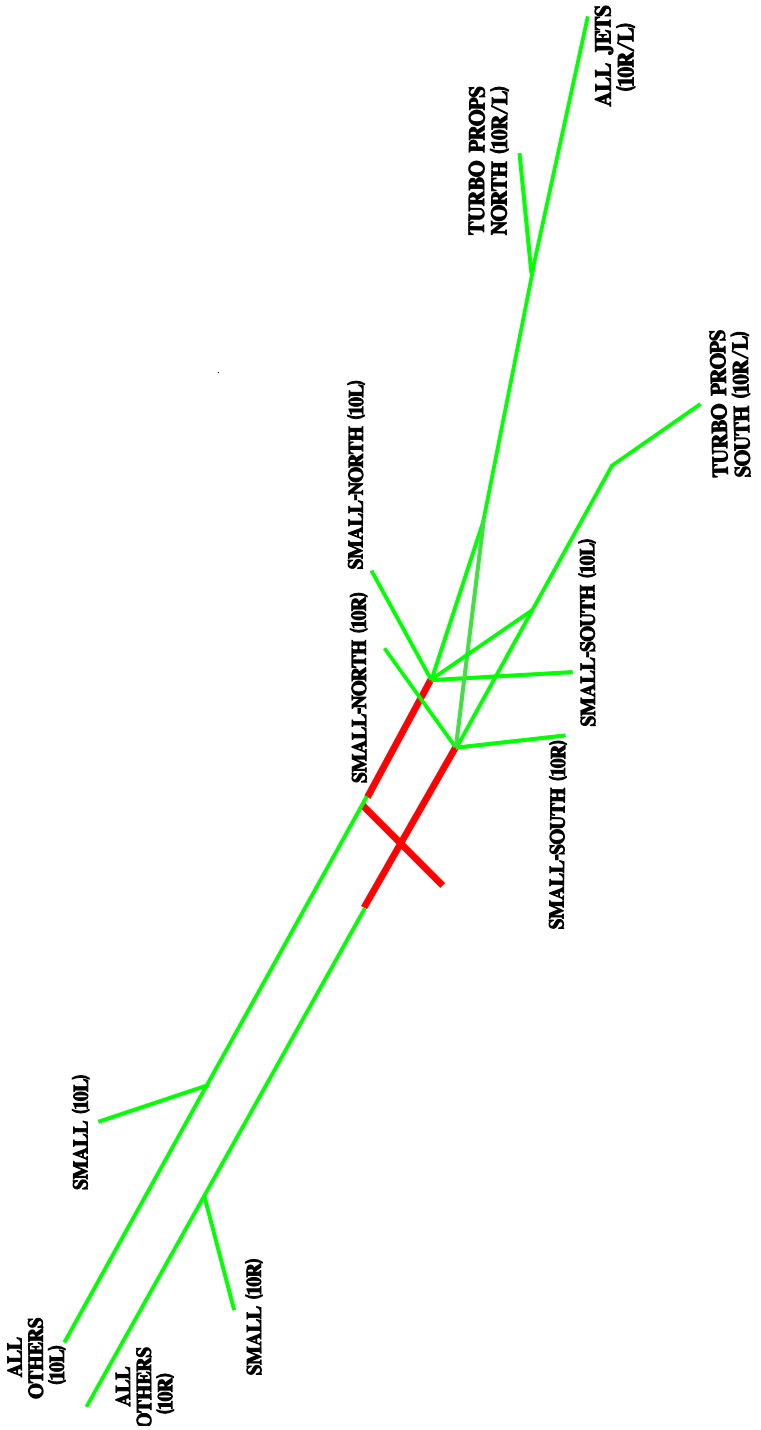
Note: **Accepted by the PDX Design Team at the meeting on July 20, 2000.**
Runway 3/21 will be considered an operational runway.
VFR2 -- any size aircraft can land on 10L and 28L.
10L & 28L have CAT I ILS -- with staggered approaches in IFR1.
10/15/01: Clarified the note on staggered approaches in IFR1.

FROM SUMMARY DATA PACKAGE–Modeling Airspace Map--WEST Flow (PDX Do-Nothing)–October 2001



Accepted 10/12/00: **Departure restrictions still apply.**
LTP and S+ aircraft classes are considered Turbo Props in this study.

FROM SUMMARY DATA PACKAGE–Modeling Airspace Map--EAST Flow (PDX Do-Nothing)–October 2001



Accepted 10/12/00: **Departure restrictions still apply.**
LTP and S+ aircraft classes are considered Turbo Props in this study.

FROM SUMMARY DATA PACKAGE – Summary of Key Inputs & Assumptions – October 2001

Annual and Daily Demand

The Design Team simulated 3 demand levels. The schedule for the 1999 demand level was developed from Tower counts and OAG data for Tuesday, July 27, 1999, and cargo schedules for August 2000.

Demand Level	Annual Operations	Daily Operations	Equivalent Days
1999(Baseline)	322,000	1,006	320
Future 1	484,000	1,512	320
Future 2	620,000	1,938	320

Note: (Annual Operations) / (Daily Operations) = Equivalent Days

Fleet Mix By Aircraft Classifications

H Heavy	757	LJ Large Jet	LTP Large Turboprop	S+ Small+	S Small	Total	
4.7%	5.2%	46.3%	17.6%	14.7%	11.5%	100.0%	1999 (Baseline)
4.9%	5.3%	47.6%	18.1%	14.0%	10.1%	100.0%	Future 1
5.0%	5.5%	48.5%	18.6%	13.5%	9.0%	100.0%	Future 2

Percentages are rounded to 1 decimal place.

Aircraft Classifications

Aircraft Classifications used were based on 1999 FAA separation standards.

VFR1/VFR2/IFR1 Simulations and VMC/IMC Conditions

The Design Team simulated 3 conditions (VFR1, VFR2, and IFR1), which reflect the runway operating conditions associated with specific ceiling and visibility minimums. They are defined in Appendix A, pages A-29 and A-30.

VFR1 and VFR2 are VMC (Visual Meteorological Conditions). IFR1 is IMC (Instrument Meteorological Conditions).

FROM SUMMARY DATA PACKAGE – Summary of Key Inputs & Assumptions – October 2001 (cont)

IMC (IFR1 Simulations)

When arrival demand consistently exceeds its capacity, its associated delays escalate dramatically. This typically occurs in IMC conditions. In reality, flights are cancelled when delays are high. However, delay reporting systems do not capture the delays associated with cancelled flights. The costs of cancelled flights include: passenger costs; hotel costs; re-issued tickets; disruptions to the schedule and bank integrity; equipment; and crew re-positioning and re-scheduling. The actual delay costs of cancelled flights are very difficult to measure because most of the information is proprietary, and the costs of cancellations and deviations vary greatly between airlines. Therefore, to capture the costs associated with cancelled flights, the Design Team simulated a full schedule in all weather conditions.

IMC/IFR1 Factor

The Design Team also simulated full days of IMC conditions. Because of the climate and terrain along the Columbia River, PDX remains in IMC conditions most of the day. Therefore, the annual delay calculations used an IMC/IFR1 Factor of 1.

Operational Procedures and Minima Simulated

The Design Team simulated the following operational procedures and minima. The percentages of occurrence were the values used in the 1996 PDX Design Team Study.

Weather	VFR1	VFR2	IFR1	
MINIMA	VISUAL	<VIS & ≥IFR	CAT I	ALL WEATHER
Ceiling:	3500'	2000'	200'	
Visibility:	10 miles	5 miles	0.5 miles	
EAST FLOW (10s)	35.3%	9.2%	7.8%	52.3%
WEST FLOW (28s)	39.1%	5.0%	3.6%	47.7%
	-----	-----	-----	-----
TOTAL	74.4%	14.2%	11.4%	100.0%

Note: 10/15/01: VFR1 and VFR2 are VMC. IFR1 is IMC.
10/15/01: VFR1, VFR2, and IFR1 refer to simulated procedures/conditions.

Fleet Mix Cost

The PDX Fleet Mix Cost is $ 1,660 per hour in the year 2000 dollars. It reflects the direct operating costs for the air carriers and non-scheduled aircraft operating at PDX.

The direct operating costs for the air carriers were for their 1st quarter 2000 costs, which were based on carrier Form 41 filings with DOT and published in *Aviation Daily*. When the 1st quarter costs were not available, the 1999 year-end costs were used. The operating costs for non-scheduled aircraft were developed using information provided by APO-110. The costs do not consider lost passenger time, disruption to airline schedules, or any other intangible factor.

Simulation Model

ADSIM, the Airfield Delay Simulation Model, was used for the simulations.

APPENDIX B

ACCEPTED MODEL INPUTS FOR THIS STUDY

ANNUAL & DAILY DEMANDS SIMULATED **Accepted by PDX Team on 1/16/03**

The new terminal will not be needed until the 484,000 operational level. This study will look at 3 Future operational levels: Future 1, Future 1.5, (new) and Future 2. Future 1 and Future 2 correspond to the Future 1 and Future 2 demand levels in the 2001 Design Team Study.

Demand Level	Annual Operations	Daily Operations	Equivalent Days
Future 1	484,000	1,512	320
Future 1.5	554,000	1,730	320
Future 2	620,000	1,938	320

Note: (Annual Operations) / (Daily Operations) = Equivalent Days

PDX FLEET MIX **Accepted by PDX Team on 1/16/03**

H Heavy		757		LJ Large Jet		LTP Large Turboprop		S+ Small+		S Small		Total		
74	4.9%	80	5.3%	720	47.6%	274	18.1%	212	14.0%	152	10.1%	1,512	100.0%	Future 1
86	5.0%	94	5.4%	832	48.1%	318	18.4%	236	13.6%	164	9.5%	1,730	100.0%	Future 1.5
97	5.0%	106	5.5%	940	48.5%	360	18.6%	261	13.5%	174	9.0%	1,938	100.0%	Future 2

Notes: Percentages are rounded to 1 decimal place.

The fleet mix for Future 1.5 was developed with the following assumptions:

- GA fleet mix percentages and number of operations are constant at all Future demands.
- Military fleet mix percentages and number of operations are constant at all Future demands.
- Air Carrier fleet mix percentages are constant at all demands. The number of Air Carrier operations changes at each demand.

Aircraft Classifications used were based on 1999 FAA separation standards.

OPERATIONAL PROCEDURES & PERCENT OCCURRENCE --Simulated **Accepted by PDX Team on 1/16/03**

This study will simulate only the VFR1 condition because this study will look only at taxi times and runway crossings. It will not look at runway delays. Since the airfield will be more congested under VFR1 conditions, simulating the VFR1 condition will provide a reasonable estimate of taxi times and runway crossings and will allow the study to focus on critical details of the simulations of the terminal locations and their affect on the PDX operations. This study will simulate the operational procedures (VFR1 conditions) as follows:

Runway Configuration:	Percent Occurrence
EAST FLOW (10s)	52.3%
WEST FLOW (28s)	47.7%
TOTAL	100.0%

FLEET MIX COST **Accepted by PDX Team on 1/16/03**

The PDX Fleet Mix Cost is $ 1,660 per hour in the year 2000 dollars. It reflects the direct operating costs for the air carriers and non-scheduled aircraft operating at PDX. **This cost was used in the 2001 study and will be used in this study.**

The direct operating costs for the air carriers were for their 1st quarter 2000 costs, which were based on carrier Form 41 filings with DOT and published in *Aviation Daily*. When the 1st quarter costs were not available, the 1999 year-end costs were used. The operating costs for non-scheduled aircraft were developed using information provided by APO-110. The costs do not consider lost passenger time, disruption to airline schedules, or any other intangible factor.

APPENDIX C

LIST OF ABBREVIATIONS

ADSIM	Airfield Delay Simulation Model
ALP	Airport Layout Plan
ARR	Arrival
ATC	Air Traffic Control
ATCT	Airport Traffic Control Tower
A&D	Arrival and Departure
Biz Jets	Business Jets
CAT	Category -- of instrument landing system
DEP	Departure
FAA	Federal Aviation Administration
GA	General Aviation
GPS	Global Positioning System
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
LDA	Localizer Directional Aid
NM	Nautical Miles
N/S	North/South
OAG	Official Airline Guide
PDX	Portland International Airport
PRM	Precision Runway Monitor
ROT	Runway Occupancy Times
RWY	Runway
SM	Statute Miles
TWY	Taxiway
TRACON	Terminal Radar Approach Control
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions